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THE CANADIAN DESERT

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TO MY WIFE

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PREFACE

The first edition of these pages, a mere pamphlet, being exhausted, I have ventured upon a second. It is not to be denied that superficially its tone is pessimistic. But this, and its sister word "optimistic," are words with little value in themselves; qualified to denote a writer's justification or his lack of it they may commend or reproach.

These pages, in my own view, that is, are rightly pessimistic of the end of the road on which we are now faring. It is a winding way with success and pleasures on many of the reaches, with disappointment and depression where we had looked for prosperity beyond the turn. These changes beguile us on our way and take our minds from the end hidden beyond the hills; it may be in a far pleasant valley or on a bleak and desolate moor. Between are many forks and cross roads. My aim is to persuade my fellow wayfarers to leave the smooth and beaten road of single crop husbandry and to seek a rougher and more toilsome, but a nobler and a safer, path.

To the extent of our failure to do this I am pessimistic—I own and avow it—not pessimistic of the country, despite its really limited capabilities, but of the inevitable result of our past and present ways of life. For deserts do not stand still; if not stayed, they march.

To awaken the inhabitants of the Canadian Desert to a closer and keener view of their actual position and the rest of the people of Canada to their own, are the objects of these pages. Many of us who live on the prairie have been for some years dimly conscious of a vague straining against some elemental force of nature paralyzing our efforts and disappointing our hopes, and have been content, or rather ill-content, to call it lack of moisture and to ascribe it to a run of bad luck, and

we have gone no deeper into its causes or their essential nature.

Even those who have been more or less conscious of the truth have hesitated to condense the phenomena of nature in western Canada into one word—desert. Yet these phenomena, cactus, short and sparse grass, prolonged drought, hot and shrivelling winds, locusts, hail and soil drifting are combined in deserts only. Our failure to perceive the true situation is partly owing to our idea that deserts are always tracts of drifting sand, totally void of vegetation, with here and there an oasis with a well and perhaps a half a dozen palm trees. These are the pictures sent home by the casual tourist. Nothing could be further from the truth as a fair picture of the average desert, though in them there are such tracts of country. With these pictures in our minds we hesitate to pronounce and apply to our own region the dread word, desert.

That there could be one in fair Canada, the land of water, rain and snow, of forests, lakes and rivers, was a thing incredible to its people and not less surprising to the rest of the world. Yet as a country with all the above ear-marks and not yielding a fair, steady and assured living to the husbandman, it is now in part a desert and in other parts easily capable of becoming one. Once this truth becomes a part of our conscious existence, we shall be in a state of mind to take concerted and sustained steps to stay its march upon us. It is in the latitude and environment of some of the great deserts of the world. What destroyed their once fertile lands and prosperous cities can destroy ours if we do not take care.

In these pages our situation will be truthfully and frankly, not to say, as some may think, brutally, exposed with all its implications, among them the inescapable consequence that to live in a desert we must, like the denizens of other deserts, make our lives conform to its limitations, its dangers, privations and hardships. If we have a higher intelligence than they, we will, of course, use it to gain a better standard of living, unless we are guilty of the unspeakable folly of thinking that,

apart from what we wrest from the land by our own work, we have a right to any given standard of living, any more than the Arab, the Tartar or the Mongol. If we insist upon following the courses which make deserts, we have only the same right as they to study its moods, avoid its dangers and gain from it the best living we can. Or is it that, in the sight of God, we have rights which they have not? The answer is apparently so obvious that the question seems idle. Yet very many people continually speak of a farmer's right or a laborer's or a merchant's right to a fair standard of living, irrespective of their judgment in the choice of a location, their manner of farming, or their industry, a belief that is sapping the foundations of our once robust independence of character and will finally make us unfit to wage the inevitable fight against aridity.

D. S.

Calgary

January 1, 1938



The Canadian Desert

I

THE FIRST STEPPE

A traveller from the east, emerging from the forest which now lies between the Lake of the Woods and Winnipeg, has before him an immense plain stretching farther than the eye can pretend to reach, south to the Canadian boundary and even farther to where Fargo now lies, north to the farthest end of Lake Winnipeg where the Nelson River takes its waters and west to an escarpment or rising ground running from the boundary near Morden north-west to and beyond the Saskatchewan River.

This entire region, now called by scientists Lake Agassiz, was once, perhaps ten thousand years ago, an actual lake of which Lakes Winnipeg, Manitoba, Winnipegosis, and some smaller sheets are but the remnants. Its southern end extended into Minnesota and Dakota, there but from sixty to eighty miles wide, coming to a point eighty miles south of where Fargo now stands, and from this extremity its eastern shore ran due north to the Canadian boundary, thence north-easterly, the low-lying area opening out to the east and the whole forming a triangular wedge driven into the continent from Hudson Bay, with its point south of Fargo. The exact position of the northern boundary of the ancient lake is not on any map available to the writer, and in any event it is irrelevant for the present. Probably it varied from era to era and we may fix it arbitrarily in the neighborhood of The Pas and Norway House, that is, at the lower end of Lake Winnipeg. Its

western shore will be described presently. It was a sheet of water larger than Lake Superior.

Through untold centuries the alluvial wash of the decayed vegetable and animal matter of the Saskatchewan, Assiniboine and Red River basins was carried into this ancient lake and there settled to the bottom, now a plain including much of the arable lands of Manitoba. It is the first level of our western prairies, the first of the three great plains or steppes between wooded Ontario and the mountains.

Many thousands of years ago, it may have been from some change to an essentially drier climate, perhaps from a cutting deeper of the channel of the Nelson River, or possibly from a subsidence of the country between the Lake and Hudson Bay, certainly because of some physical change, this lake was drained down to the level of the remnants above named, leaving elsewhere a level plain with a vegetable soil of almost immeasurable depth and richness.

When great richness of soil obtains it means as a rule an abundance or great depth of the top layer, which is composed of the remains of organic matter, such as dead leaves, grass, trees, either grown on the land or brought down by water from higher lands, together with animal remains from tiny insects to large mammals. It is known, though somewhat loosely, as humus. Its qualities will be discussed hereafter, but it may be said at once that it can be worn out, burnt out, blown away or removed in the crops grown upon it, but in that part of the plain under discussion—the old bed of Lake Agassiz—its depth was such that these results were scarcely thought of. It was considered, and indeed pronounced, inexhaustible. How far this verdict was justified will be considered hereafter.

The boundaries, that is the banks which enclosed this now non-existent lake, are yet to be traced as easily as if the waters were still there. Leaving aside its northern, southern and eastern limits as not of immediate interest, the western boundary was the rise of land which can be followed for four hundred miles; beginning at the International Boundary (for our present purpose),

south-east of Morden, where the easterly side of Pembina Mountain gives it a buttress or bastion, it proceeds north-westerly, crossing the Canadian Pacific Railway main line between Portage la Prairie and Brandon near Macgregor Station, thence to Neepawa and Dauphin, between which the Riding Mountain forms another bastion, thence more westerly where Duck Mountain and the Porcupine Hills once towered above the waters. The banks then run into Saskatchewan, with the Pasquia Hills as their supports, and thence more westerly cross the Carrot River and the Saskatchewan above Fort à la Corne, and finally run north-easterly into Manitoba again, to the intersection of longitude 57 and latitude 100 not far from Flin Flon Lake. Beyond the North Saskatchewan, however, it loses interest for our present purposes.

While the line we have traced formed the western bank of the old lake it is now the eastern edge of the second steppe. The fateful change of the character of the land at this line will soon engage our attention. It is obvious to one following the ancient shores or coast line of the lake, that a very large part of Manitoba, the south-western triangle, was not covered by its waters and did not share its rich alluvial deposits. It is not on the first but on the second steppe, shortly to be described. The Birtle, Virden, Brandon, Souris, Deloraine, and Turtle Mountain districts therefore share the characteristics of the higher and drier region.

We must call attention to the scarcity of water on our prairie lands and while the first plain is under discussion, the water-soaked condition of all that part of Manitoba west and north-west of Lake Winnipeg and east of the rising ground we have described must not escape our notice. It has emerged, but barely emerged, from the waters of the old lake. It is still a welter of shallow lakes with the water table or level where the land shows but a matter of inches below the surface. The waters of the two Saskatchewan, sorely needed on the parched lands of the second and third steppes are here prodigally used in saturating the marshy wastes of north-western Manitoba. In the common valley

of the Carrot and lower Saskatchewan Rivers a million acres are annually inundated. (Walter Blue, A.M.E.I.C., in paper read at Civil Engineers' Institute, 1935.)

From lack of knowledge we have blithely made mistakes in dealing with the empire which was thrown into our laps in 1870. Of them all, this prodigious and continuous squandering of our precious water is perhaps the least excusable. Fifty-six million tons of water flow past Fort à la Corne every twenty-four hours and it is smiled at as an ingenuous and artless suggestion that we should spend part of our relief money in damming our two great rivers to put their water on the thirsty steppes.

Instead of doing so, we are spending millions of dollars to put paved roads through them. To any one viewing in his mind the two areas at a glance, the arid and the inundated, our conduct must surely appear to touch the confines of the scandalous. It is, however, in harmony with our usual courses in the west—we seek to enjoy the fruits, before we ensure the foundations of prosperity. In the meantime we have the statement of Mr. Blue that a dam across the South Saskatchewan at the Elbow below Aiktow Creek, would store two billion cubic feet of water in the deep river bed and that the annual flow of the river at its minimum is sufficient to fill it every year.

II

THE SECOND STEPPE

When one, still travelling westward, climbs the hills and rising ground forming the western banks of the old lake, he finds with surprise that, in a measure, they have but one side. He does not, as he expected, travel downward on the other side. He but finds himself on another and higher plain with the hills he has climbed making the broken edge of it. He has before him the second steppe or plateau of the West, its width two hundred and twenty miles from east to west. It differs in its quality from the lake bed he has left. The monotonous dead level no longer obtains. The wide basins of the Assiniboine and Qu'Appelle tend to keep up the illusion of similarity, but they are bordered by low hills and rolling landscapes with minor or secondary plateaux rising above the general level. The scene is more diversified, here are heights of land taking the name though hardly the rank of mountains; there the wooded sides of deep valleys where spruce and aspen, cottonwood, the Balm of Gilead and pine are growing green to break the rolling lines of the plain, while beautiful lakes are not wanting. Although with these are alkali flats and hills of blowing sand, there are also vast and beautiful open stretches of fertile prairie varied with savannahs and pasture meadows. If he wanders to the north he finds that the open plains become interspersed with grove and copse, with the fascination of natural and beautiful parks, while in other parts the woods become more extensive and in places continuous.

To the south is the elevated stretch of country called Moose Mountain, with its broken surfaces and wooded hills at its southern end and with Turtle Mountain at the boundary. North and north-east of Fort Qu'Appelle, where the river of that name broadens out to make the Fishing Lakes, is the rough country of the Pheasant and File Hills, the Little Touchwood and the Lost Hills, and then the Beaver and Great Touchwood and farther north the Greenwater and Birch Hills and the western

end of the Pasquia range. These, with many lakes between, diversify the prairie. This broken and partly-wooded region continues northward to the Carrot and Saskatchewan rivers. In it are the headwaters of the Assiniboine. It has good soil, which is not adapted to machine farming, but is fitted rather for stock-raising and mixed farming. As always where this way of life prevails, its followers will likely give our governments little anxiety, for they have little themselves.

It is west and south of this broken country where lies the open rolling prairie from Saskatoon, Outlook and the Elbow south to Moose Jaw and Regina, thence south-east to the International Boundary, including the south-eastern triangle of Manitoba which, as above stated, forms part of this second plateau as to elevation, soil and other characteristics, but with generally an inch more rainfall. It is here, upon this open prairie region that wheat farming in a large way has been carried on and soil drifting and farm abandonments have prevailed; the cause and the effect of which is left for the present to the reader's judgment. It will be noticed from the rainfall map that in the growing season the south-easterly part of this region has ten inches of rain or in places a little more. The greater average rainfall in the south-eastern part of Manitoba lends force to Mr. Lange's contention that our moisture comes from the region of the Great Lakes. It meets near the Rockies a cold wind from the north-west, increasing the rainfall.

North and west of Saskatoon extends what was once a park-like country to Battleford, but there the spring and summer moisture has fallen to nine inches.

Where men were at work on the great railway through this plain the cuttings of the sod would show nearer five inches of the dark humus soil than the five feet of the lake bed our traveller had left behind.

The prairie had existed for perhaps tens of thousands of years: there was nothing to indicate the existence of a forest since the ice cap melted. In all these vast aeons the plain had accumulated but four or five inches of the precious humus, the indispensable living soil lying above the dead sand, clay or gravel.

The supply was not prodigal, far from it. But, if it were lost could a man in his short life do the work on which Nature had spent perhaps ten thousand years?

However, it was found that the greater part of this plateau had sufficient humus for many years, that the sub-soils were good and not deficient in the necessary mineral elements, and that it would probably yield rich crops for many years, with a fair supply of moisture.

As will be more fully discussed below, the well-known but inferior Wooded or Grey Soils prevail over the whole of the second plain north of the latitude of Prince Albert, or more accurately north of a line drawn east and west fifteen miles north of that city.

Then beyond that river the rainfall becomes less and less as one goes north, and so, with poor soil added, its problems will not likely be dealt with for years to come. The warnings of the hydrologist engineers will do no harm if inserted here: that when its woods are cut down it will be much easier to make it a desert.

Thus far we have only considered the country south of the North Saskatchewan, and out of this we again set aside the hilly, broken, partly-wooded and lake-strewn north-eastern angle. On this plateau, then, we have two types of country, first the level, treeless plain and secondly the more broken hill areas with woods and small lakelets and greater rainfall according to the height and wooded covering of the hills.

Normally the first type suffers more from drought, but half a century ago it was covered with a carpet of grass which radiated little of the rain-preventing heat in comparison with the hot sand and rocks of actual deserts or with our extensive summer fallows.

Taking it all in all, it was a variegated, fertile and beautiful plateau. It had forest and wooded hills, lakes and parklands to please the senses and then the swelling open plains to excite the imagination with pictures of waving grain fields and hamlets, towns and cities all prosperous and contented. If we had but known its limitations and the thin margin between this picture and semi-aridity we might have followed the courses that these limitations relentlessly impose.

III

THE THIRD STEPPE

Thus journeying still westward and having left Moose Jaw say fifteen miles behind him, or, if on a route further north, having passed Saskatoon by forty miles, the traveller sees before him another abrupt rise in the ground. He is face to face with the escarpment of the vast upland tract known as the Missouri Coteau. This plateau is not merely a Canadian, but a continental, feature, the last and highest of the upland plain west of the Red and Mississippi rivers stretching to the foothills of the Rockies, which rise in long, rolling ridges parallel to the mountains, often crowned with rocky outcrops like a cock's hackles, with long verdant valleys between. Beginning at the Rio Grande in western Texas, its eastern edge persists through the Panhandle of Oklahoma, eastern Colorado, western Nebraska, South Dakota where the Black Hills form part of the escarpment, then along the boundary between North Dakota and Montana. It enters Canada thirty miles west of Portal, looks down upon Moose Jaw and then crosses the South Saskatchewan on which its declivity causes the rapids west of Riverhurst. Its eastern escarpment on entering Canada is buttressed, though at some little distance, by Woody Mountain, then by the Cactus and Scratching Hills west and south-west of Moose Jaw, the Vermilion Hills south, and the Little Coteau and White Bear Hills north of the South Saskatchewan. Then the Bad, the Bear and the Eagle Hills bring us to the North Saskatchewan just east of Battleford, where the Thickwood Hills carry the high coteau due north. The escarpment then trends north-westward, supported by the Moose and Pheasant Hills, where the rising ground trends into Alberta and so on to Fort McMurray, beyond which we need not follow it. As the first steppe or plain, the so-called Agassiz lake bed, is 900 feet above sea level and the second is 1,600, so the third, on which we are now entering, is 3,000 feet above the sea. But this is the average, and at its eastern edge or escarpment

it would vary from 400 to 500 feet, or even less, above the second plain.

The width of this plain is roughly 330 miles from Battleford west to the Big Horn Hills and 400 from Moose Jaw to the Porcupines, where, as one may say, the foothills of the Rockies break up its even upward slope.

It will not be amiss to speak of the area immediately east of the actual foothills as a secondary or minor plateau raised with a fairly distinct escarpment above the rest of the Missouri Coteau. The eastern side of this higher level begins, say, 40 miles east of Coutts, thence to Lethbridge, Lamont, Arrowwood, Gleichen, Irricana, Delburne, there called the Alberta Highlands, thence north-west conformably to the trend of the still higher foothills. The rise in height at its eastern edge or escarpment is from 200 to 300 feet, but it is fairly gradual. With this rise in height the rainfall also rises as compared with the lower levels to the east. Again, as the second steppe, though with immense areas of fertile lands, is not as uniformly rich as the first, so, taken as a whole, the third plain, as grain-growing lands, is inferior to the second.

This, however, must be taken with a most important exception. Occupying a large part, about eight million acres, of central southern Alberta there is a tract of land somewhat in the shape of a very irregular triangle, of which the base is a line from Athabaska nearly to Calgary at a distance of thirty-five to forty miles west of the Calgary and Edmonton Railway. The apex of the triangle is almost due east of Edmonton, at a point forty-five miles or thereabouts within the Saskatchewan border. The hypotenuse of the triangle is its southern boundary and runs from nearly Calgary, touching Stettler and Vermilion, thence to or a little north of Lloydminster and on to its point in Saskatchewan. This tract combines rich, black soil with a summer rainfall of from ten to thirteen inches. It is at present partially wooded and even given that our present deplorable farming methods continue it should be the last region to succumb to soil drifting. Its mixed farming, dairying and

cattle, sheep and swine breeding activities in some parts of the area are noted with the greatest satisfaction.

Although the region just described is the best part of the third plateau, yet the remainder has great areas of most productive soils. On the other hand it has its Bad Lands, and until the foothills region is reached its rainfall is quite insufficient for successful farming under our present methods and objectives. It has, however, most excellent grazing land throughout almost its whole extent, with most nutritious if short grasses. With scores of mountain streams most copious in their flow in hot and dry weather, its neglected opportunities for irrigation are perhaps the greatest in the world. At varying distances, from fifteen miles at the south to a hundred at the north, west of the Calgary and Edmonton Railway, begins the foothills region, in some ways in a class of its own. It is also a mixed farming and ranching country and for its future little danger is to be apprehended. Yet it is within a zone where the annual precipitation of moisture is less than twenty inches, and without more there is always a danger.

The settlement of the third steppe was more gradual than the first and second. Roughly it took place mainly in the early part of this century and its high tide was in 1907, 1908 and 1909. The much earlier arrival of cattle and sheep men in the foothills, coming by way of Montana, is not overlooked, but it is not with their activities we are chiefly concerned. They have not contributed to the regrettable change which has come over our farm lands. On the contrary, they were the strongest opponents of farm settlement, of homesteading and the breaking up of the prairie sod. Some of the earliest cattle and sheep men have lived to see the dire results which they predicted. That their views coincided with their interests is but a trivial reproach when we now see that they also coincided with the permanent interests of the country.

IV

THE ARMY OF SETTLERS

Into this virginal domain, spacious and fascinating, there came from Eastern Canada in the summer of 1882, a great army. Their concentration camp was Winnipeg and from there they marched westward. Except that it was peaceable this army resembled that of Genghis Khan, which overran and partially devastated all of Western Asia and much of Eastern Europe. Like the Mongols it was accompanied by women and children, who carried with them their household goods if not their household gods. Like them it left detachments to take possession of the land through which it marched, the first of these occupying the first steppe or plain, the rich alluvial lacustrine valley of the Red River of the North, the old lake bed just described.

Proceeding westward our peaceable army climbed up from this flat plain to the hills and slopes which formed the western boundary of the first steppe, a plateau of a different character, leaving behind, unwitting of the serious character of the step they were thus taking, the land of rich, deep, black alluvial soil and more copious rains.

The settlers then dispersed over the whole of the second great plain, and, as did the garrison left in the old lake bed, proceeded to possess themselves of what seemed to each the choicest lands. "The world seemed all before them where to choose," and in a day each found himself, without money and without price, possessed of land equal to a knight's fee and almost enough to support a manor in the old feudal days.

There is no doubt that the first settlers, largely from the eastern provinces of Canada, came into possession of this beautiful country with the idea of carrying on farming operations in the same manner as they had done in the East, that is to say, farming with all kinds of stock, with the usual farming activities that prevailed in their former homes, where the practice of crop rotation had been followed. It was the immemorial habit

of farm life as they knew it; come down from the ages, as the saying has it, "From a time when the memory of man runneth not to the contrary."

On the plains of Mesopotamia, of India and of China the simple peasants, unconscious of chemistry, biology or of the mineralogy of soils, and not knowing the meaning of such words, had by dint of hard experience learned that wheat must not follow wheat nor corn follow corn: that plants bearing pods left their land better for the next crop and that manure from their stables brought a sure reward for the labor of carrying it to their fields. Before the dawn of history these things, instead of lessons to be taught and learned, had become an instinct with the husbandmen of the old world.

Not only have these rules an ancient pedigree; they have been repeated *ad infinitum* by every farm paper and magazine and every book on soils and by every other writer on the subject in North America, several of whom, as Shutte of Ottawa, Fletcher of Michigan, Olen of Utah, Hopkins of Illinois and King of Wisconsin, declare in effect, and some in the very words, that their neglect is the farmer's easy road to certain ruin.

One does not wish to say that the desertion of these long-tried and well-known rules and methods of agriculture was a deliberate or even a conscious act, or a series of such acts. But those who broke them were grown men and knew the methods of their fathers and indeed their own methods in the East. They well knew the simple reason for the old methods that no land can be treated as an inexhaustible reservoir of wealth without replenishment. They cannot be absolved from the blame of their economic mistake. Two courses were open to them. First to follow these methods of the old world and of eastern North America, to maintain their soil by crop rotations, barnyard manures, clover and other legumes, with cattle of all kinds in proportion to their grain fields, and for water, wells and windmills, the last involving, it is true, some labor and expense. If pastures grew short for their cattle then resort could be had to soiling.

The second method was the easier, softer road, for it

could almost to the last detail be travelled on the seats of tractors, and the growing of grain, and particularly wheat, soon became the exclusive occupation of the great bulk of the farming population. There were several immediate advantages in this, or at least reasons for it. Farm crops divide themselves into soil-depleting on one hand, as wheat, oats and barley, and soil-preserving or soil-building on the other, as peas, beans, alfalfa, clover and vetches. The former, and especially wheat, requires less moisture; is easy to sow, reap and thresh with machinery; is easy to transfer in bulk from the farm; is sure of a market at the elevator; commands prices generally remunerative; and requires scarcely any manual labor.

The soil-preserving crops, on the other hand, have, some but one or two, others none of these advantages. As time went on machinery was developed especially suited to grain farming in a larger and larger way and it was found that, with such machinery, the time occupied in sowing, growing and disposing of a crop of wheat would not amount to more than sixty days. Machinery for the soil-building crops was not so fully efficacious and so more manual labor was required, and this in turn curtailed their production and probably their popularity.

Wheat soon took the first place in the farmer's favor and in a few years became, if not the only, at any rate the staple crop, and the thoughts of the farmer and grain companies, the railways, the mortgage companies and the banks were absorbed in its production, storage, sale, transportation and financing and the implement manufacturers busied themselves in supplying machinery for its every incident. The situation became dazzling in its success. Wheat was a soil-destroying product, yet even where rain was somewhat deficient, as it sometimes was, the virgin water-holding humus generally rescued the crop from failure. But more water from the clouds was now required for an equal crop, one cause being found, not only in the lessening amount of humus, but in its deteriorated quality. Much of it, unrenewed with barnyard or green

manures, was now dead humus, still with a certain water-holding capacity, but far inferior to the quick or living.

Coincident with the drift to wheat-farming came a most portentous change in the domestic life and economy of the farmer's household. It became the custom to rely on the returns from these excellent crops to provide not only all the food, but all the other necessities and "desirables" of the family. The farmer's way of life became in its essence that of a dweller in the city, who produces and sells his goods and buys everything with the profits of his industry, a result considered desirable and even an ideal to be attained. Some went further, and their wheat, their sole product, safely delivered to the elevator, removed with their families to the city for the six or seven months in which no grain farming work can be done.

How little other work is attempted can easily be estimated when we read in the Dominion Agriculture Bulletin, number 130 N.S., that in 1926, 96 per cent of all cultivated land in the western provinces was sown to grain with wheat as the principal and most profitable crop. In 1935, 94 per cent was in wheat or in summer fallow for wheat, in Saskatchewan. How false and unsound economically, how harmful mentally, how destructive of morale will be, not obvious perhaps, but accessible to our minds if we but think—96 per cent of our farming population, strong and healthy, demanding as their right twelve months of a high standard of living, special roads, amusements and every other concomitant of prosperity, on sixty days' work in the year!

And so it came about at a fairly early stage that the farmer's *ménage*, his wheat factory, consisted of his dwelling house and a stable for from four to twelve or even sixteen plough-horses and their winter fodder. Gardens, the household arts, spinning, weaving, even the homely knitting, the curing of bacon and hams, "preserves," butter-making, all were cast aside, and became lost arts.

It is gladly admitted that this picture is not one universally true, and especially untrue in districts where the prairie is broken by wooded hills and lakes, where

the rainfall is more abundant and where there are either running streams, strong springs of water, little lakes or perennial sloughs. But elsewhere under the conditions outlined above, it soon came about that more of the prairie was ploughed up, the area under wheat quickly increased and the alert machine manufacturers did not fail to provide larger and wider implements so that a single driver could cover wider swathes with plough, seed drill and harvester. Then came the small and handy tractor. It required less technical knowledge and skill from its driver. It is not an uncommon boast of a grain farmer that he has, unaided, summer-fallowed and in due course seeded 500 to 600 or even 700 acres. The use of the horse decreased and the machinery not requiring food, the winter work of the farmer was on its way to extinction and his desertion of it for the city seemed a logical consequence—if he were condemned or had condemned himself to idleness for six or seven months the place to enjoy it was the town with its congenial company and amusements; also, a justification, its better schools and unfortunately its wheat-gambling rooms.

The first warning against the methods he had been using, not from the books and farm magazines, but physically, plain and open to the farmer himself in his own fields, was the beginning of soil drifting, though for some years his average yield of wheat per acre had been low, with, however, still bountiful returns in seasons of copious rains. These rainy years buoyed him up with a belief of his fields going back to their pristine fertility and production. But the loss of his seed beds and, if the winds came after sowing, the loss of his seed as well, could not be ignored. The dream of this soil returning by two or three rainy seasons to its original strength has been and is yet a favorite soporific with the inveterate grain farmer, his fond castle in the air. As well believe that an unreplenished bank account or a cistern unrefilled, can be drawn upon and drained forever.

The more intelligent easily saw that the original root fibre of the nature grasses, never very abundant, which had held the soil together, had been ploughed, harrowed,

“cultivated” and drilled to dust, while no clover, alfalfa or other legumes had been grown to keep up the supply, and no farmyard manures had been spread to be ploughed in to break the force of the wind upon the light vegetable dust. That the chemical, biological and bacterial life of the soil had received through all the years of incessant wheat cropping a deadlier blow was not so apparent.

But what everyone knows right well was, that the prairie farmers had departed, not wantonly yet persistently, from the course of farming they had known and followed in the East, had entered upon a new and easy path in a new region, and had cast aside every known canon of good farming to try experiments, where the sagebrush and the cactus should have told them that water, grass and vegetable matter were scarce and that they should be most carefully husbanded.

The calamitous result has come and we are getting alms from the East and asserting that it has been no fault of our own.

V

THE DESERTS OF THE WORLD

There is unfortunately a great deal of the earth's surface upon which so little rain falls that it either barely supports animal life or entirely fails to do so. If these regions occur in other countries, we frankly call them deserts. So in general do the people living in or near them. Thus the names Sahara, Gobi (the Sandy Sea), Karroo (Hottentot for dry or barren), Kalahari and others mean practically the same as our word "desert," though in the Bible the Hebrew word is translated "wilderness." (And Solomon built Tadmor in the "wilderness."—1 Kings). This "wilderness" is now the desert lying between Syria and the Euphrates, though it could not then have been an absolute desert, or why or how build a city there? The fact is that though it was a desert when the Hebrew scribes of a much later date wrote the first Kings, it was in Solomon's time what our semi-arid plains were in 1880. Excessive cultivation by improper methods turned it into a sand-blown plain and then the queenly city was abandoned like a mining town when the foundation of its existence has gone.

A short survey of the deserts, steppes and steppe deserts of the Old World, and the causes of their aridity, will help us to estimate the comparative position and character of our own. For this it will be most convenient to turn to that immense region which, under various names, stretches across Africa and Asia, a region over 9,000 miles long and, roughly speaking, from 1,000 to 2,000 miles broad, but narrowing at the extreme eastern end near the borders of Manchuria. If one looks carefully at a rainfall map it becomes plain that beginning one's journey at the south-west corner of the Sahara one might undertake to travel in a straight line through 130 degrees of latitude, one-third of the way around the earth, without being out of some desert except for short intervals.

One's footsteps, or more likely his camel path, on

the Sahara from the Atlantic will be for the first part of his journey on a barren plain of sand or gravel. Passing Timbuktu on his right he reaches the oasis of Air or Aer, many miles in extent, with grain fields, pastures and groves of palms, thence to the Borku and Ennedi, oases with varying supplies of water and pasture.

It will, however, be more interesting to take a more northerly course. If one begins at Figuig on the southern boundary of Algiers one may travel many days from one kasir (walled village) to another, all in oases with pasture lands between to the town of In-Salah and the palm groves and pastures of Tidekelt and Tuat. This single, though not unbroken, strip of verdure, called by the Arabs the Street of Palms, is more than 400 miles long. Its whole course is underlain with water, but at a considerable depth, and the people, mainly Tuaregs, who control the region have with prodigious labor, by their tenants, be it understood, excavated great underground reservoirs in some cases 200 to 230 feet below the surface. From these they construct aqueducts, or fogarras as they are called, with frequent openings through which to draw up the earth dug out. At Tatament in Upper Tuat some of these tunnels run to a length of twenty-five miles. The additional labor involved is very great and dangerous until the aqueducts are lined with stone, but the workers have their reward in water for their crops, palm trees and cattle. Practically the same irrigation supply channels under the loëss are made by the peasants in Chinese Turkestan and Baluchistan, where the irrigation tunnels, there called Kariz, are at the bottom of the loëss, with this great difference, that no support is needed.

From Tidekelt, a well watered depression, or one may call it one large oasis 200 miles by 50 miles, one may travel comfortably or at least safely from oasis to oasis down to Timbuktu on the Niger.

Most of the journey will have been along the western wall of a great irregular plateau stretching from Tidekelt into the Egyptian Sudan, which, from its height and immense extent, now claims our attention. Much of

the Sahara is lower than the uplands of Morocco and Algiers on the north and the western Sudan on the south. Beginning at somewhat less than half of the way from the Atlantic to the Nile, this plateau dominates the central and eastern desert, running south-east into the eastern or British Sudan. North of the plateau is Fezzan with its strong group of wells for 100 miles, with outlying wells and pastures north and south 200 miles each way. The water is on or near the surface and the many lakes and lakelets are always encircled by date-palm trees. The population of Fezzan is said to be 50,000, but it is also said that 12,000 is nearer the fact. South-west from Fezzan and still on the plateau one encounters the mountains of the Tibesti, which rise to 11,000 feet with an extinct volcano as the highest. From Tibesti one easily reaches Lake Chad in the now British and French Cameroons, passing through a watered region called the Chad Netherlands, an area 100 miles by 50 miles. Lake Chad has no surface but an underground outlet which takes its waters to these low lands.

There are, of course, immense tracts of sandy wastes in the Sahara, waterless and ever-drifting. But there are also large tracts of oases or watered lands and pastures, as indeed there must be to feed its inhabitants, estimated by some at two and a half millions. Some oases, such as Taghit and Beni Abbes, have springs of running water, but generally in the western Sahara water must be sought by artesian wells or artificial underground reservoirs with fogarras to the lands to be cultivated.

The water which supplies all, or at any rate most of, the oases of the Sahara comes originally from the higher regions, the Atlas Mountains at the north, the rivers or wadies of which soon lose themselves from the eye, but nevertheless continue underground in the wadi beds for many miles. At the south such rivers or wadies come from the western Sudan, the highlands of the Niger, Nigeria and Lake Chad. A certain limited supply is the run-off from the higher plateaux which have been described. These often have rain, sometimes in huge cloudbursts and occasional snowstorms in which people

have been known to perish. The total average amount per annum from rain is small; it is given as 3.94 inches for the whole desert. These facts are mentioned as the basis of a parallel to be drawn between the water supply of the Sahara and what is done with it by its inhabitants and the water supply upon our prairies, both from rainfall and from our mountains, and what we do with it. An account of the latter can be short. What falls on our grain fields is, of course, usefully employed, willy nilly. Very little of the run-off is collected or utilized and the same must be said of the prodigious flow of our mountain streams and rivers which run "unharnessed and unvext" into Hudson Bay, 56,000,000 tons daily. Absolutely necessary as these waters are to our crops, if they were taken from their present beds with the main stream kept upon the high land or watershed, to flow (not mainly for irrigation) down our own dry wadies and coulees and into our ponds, sloughs and lakelets, the prairie would present a different aspect, and, with water everywhere for cattle, it would also have a different economic value. The farmers could keep cattle, would grow legumes for their winter feed, would have root fibre in the soil, would restore life in the humus, would stop soil drifting and stay the march of the desert. It is in short the William Pearce plan.

But why these fond imaginings in a country given over to grain miners and relief claimants and statesmen whose highest flight of statecraft is to dole out millions for relief or to spend it on roads through unwatered wastes. From these we turn with pleasure now to the Berbers, the Tuaregs, Tibbus and Kabyles of the Sahara.

Leaving the Sahara one travels over the Anglo-Egyptian Sudan, a pronounced desert in the north-west, but elsewhere more generally productive than the Sahara, though really its prolongation. It supports a population of three millions. Of course, one crosses on his way the strip of emerald green vegetation in the narrow valley of the Nile. Reaching the Red Sea one probably takes a ship from Suakim and will likely have the advantage of the company of perhaps 500 Mohammedan pilgrims, each with his prayer-mat and his pros-

trations with the forehead on the deck in the direction of the sacred city, all bound for Jiddah, the seaport of Mecca.

Landing at Jiddah, we have before us, surprising as it may be, a situation in its essential features a duplication of our own. The moisture-laden winds from Abyssinia and the equatorial swamps and lakes at the source of the Nile, strike a mountain range parallel to the coast at about forty miles to fifty miles inland. The winds lose their moisture on these mountains. Hence the long but narrow strips of watered country on both sides of the range, formerly called Happy Arabia (Arabia Felix) and now the kingdoms of Hejaz, Asir and Yemen, with a population of three millions. Its western side corresponds to British Columbia, its eastern is our Alberta foothill area. The wind which, then denuded of its moisture, blows over the rest of Arabia, is their Chinook. As we know, the Chinook, though delightfully balmy, brings no moisture to our plains, but on the contrary absorbs what we have. Arabia, whose people number from seven to ten millions, has also a large highland region, the Nejd, a steppe where rain falls and grain and fruits are grown in its valleys. It corresponds to the region east of Edmonton and to our Sweet Grass and Cypress Hills and Woody Mountain country. It is always the same, whether it is the Sahara, Arabia or our western plains, the higher lands, plateaux or hills, the Tibesti and Nejd, the Porcupine, the Cypress and the Touchwood Hills; their colder atmosphere will bring more rain than the burning plains, whether the latter have eternal sand and rock or have by cultivation attained their equivalent, the summer fallow, as far as driving off rain and causing evaporation is concerned. From Arabia we cross the valleys of the Euphrates and Tigris, struggling to regain by irrigation their former prosperity. In Persia, in the dry Seistan basin, and in Afghanistan and Baluchistan, the phenomena which one finds are the same, rain and snow on the mountains and highlands; on the adjacent slopes and foothills streams and springs from the mountains, in some cases losing themselves in the sands, in others, according to the

reports of certain English engineers, being almost entirely absorbed in irrigation by the Afghan peasants on their little farms.

North of the Elburz and the Hindu Kush, after the usual well-watered foothills, there are the steppe deserts of Russian Turkestan, the Kara Kum and Kizel Kum. The rain clouds from the Indian Ocean, driven upward by the mountains into a stratum of cold air above them, there lose their moisture on the peaks and sides of the range and reach the plains on the leeward side as dry and warm winds. Here the rivers Jaxartes and Oxus, "the shorn and parcelled Oxus," trend east and north through a piedmont, a foothill country where their waters are absorbed by irrigation, leaving little in their beds to traverse the dry plains until they trickle into the salt sea of Aral. It is in this irrigated area that the storied cities of Central Asia are to be found, Samarcand, Khokan, Bokhara and Tashkent. Their relative situation is that of Lethbridge, Calgary and Red Deer. They are in the area between the rain abstracting mountains and the arid plains and get some of the moisture which has escaped from the former.

Similarly the monsoons of India leave their moisture on the Himalayas and blow over the dry upland steppe desert of Tibet. North of Tibet is Chinese Turkestan, nearly surrounded by lofty mountains, the Kara Korum on the south, the Pamirs on the east, the Tian Shan on the north and, between it and Tibet, the Kuen Lun above mentioned. The enclosed area is the Tarim or Lob Nor Basin or Hakla Makan Desert. But first comes the foothills area, an immense semi-circle, or more properly an ellipse, 100 miles or more in width between the surrounding mountains and the dry steppe lands in the centre. In this fertile well-watered circular belt are flourishing cities, Kashgar and Yarkand and other towns and cities. Khotan, also once thriving, has been almost buried by the sands. Beyond this zone comes the short grass and then the sand and rock. The Yarkand and Tarin rivers flow down from the mountains and into the plain for perhaps 600 miles, when what has not been taken by irrigation disappears in the sands.

Part of the rest has grass and is a steppe desert, but an immense tract is sand only, a veritable waste.

The situation of Kashgar and Yarkand each with 60,000 souls on the slopes of the Pamirs and the Tian Shan is again like Calgary and Lethbridge, or any other town and cities in our foothill district between the Rockies and our arid plains. The Tarim and the Yarkand rivers, with their snow water, rush through them and, less what is taken for irrigation, run into the sandy saline swamps of the Lob Nor (salt lake), for like the Caspian and Aral seas it has no outlet. It is near the western end of the Great Wall of China.

Next comes the Great Gobi. It does not differ from the others, partly desert, partly steppe with grass, and near the mountains an agricultural area where, what with some rain and some irrigation, the farmers can feel certain of a fair yield. The views of certain scientists well qualified to speak, that rain does not escape the mountains to fall on the foothills on their lee side, has not escaped the writer's attention, but a somewhat prolonged residence within sight of the Rockies has often enabled him to observe the phenomena of a night of rain at Calgary with the mountains covered with snow in the morning as if from the same source. No conclusive evidence, of course, but it is hard to believe that both rain and snow on the mountains came from the east. It is hard to reconcile all the conflicting views.

That well-known work, the *Encyclopaedia Britannica*, in giving a list of deserts, the Arabian, the Atacama, the Indian, the West Australian, and several others along with these named, speaks of the Great American "Basin." From what has already been said, and from a glance at a bathy-orographical map of North America (one showing mountains and depressions), one will at once expect a desert east of the first mountain range which intercepts the rain-laden clouds from the Pacific. Accordingly there is a plateau immediately east, not of the main continental divide, but of the secondary range near the coast. This is called the Cascade Mountains in Oregon and Washington and

British Columbia the Sierra Nevada in California and the Coast Range in Mexico; where it forms the backbone of Lower California. This pronounced desert or "basin" includes parts of Washington, Idaho, Oregon, Colorado, New Mexico and California, and practically all of Utah, Nevada, and Arizona. In Southern California it has received the name of the Mohave and in Arizona the Gila Desert. It extends into Old Mexico and is there called the Chihuahua (Che-wa-wa) Desert. It runs north into British Columbia and is there represented by the dry area of which Kamloops may be regarded as the centre. But in that province, a colder region, a large part of the moisture reaches the Selkirks and a very considerable portion of it the Rockies, and, as we have seen, it also gives fair rainfall to the foothill extensions of the latter, to Calgary and Red Deer and Edmonton and to a considerable distance eastward of the last. These regions are mentioned here to remind us that North America is by no means immune from regions of complete aridity. For that matter there are two deserts in the state of Maine, quite small certainly.

Besides this veritable desert, the Great American Basin, there is another vast tract whose arid character is not so pronounced. Some of us remember Olney's School Outline Maps of the continents. That of North America showed a dun-colored tract lying mainly east of the Rockies and west of a line drawn at such a distance west of the Mississippi and the Red River as to exclude the tier of states bordering on the former, from Minnesota to Louisiana, and so covering eastern New Mexico, Western Texas, Eastern Colorado, Kansas, Eastern Wyoming, Nebraska, Montana and the Dakotas, and extending into Canada to about where Saskatoon, Wainwright and Stettler now are. With a frankness which our current maps do not emulate, it bore the legend, "The Great American Desert."

The former, the more western basin, is a true desert and was so when first known to the white man; the latter is also a desolate waste in some regions, in other

parts it was originally a steppe and is now undergoing conversion into an actual desert.

We must keep in mind the fact that deserts grow, and that we should take every means to prevent, and not assist in, their growth. It is the scientific fact, as shown elsewhere, that where the backbone of a continent (the Rockies in North America, the Draken Bergen in Africa), runs north and south, the windward side gets rain, the lee side, except for a short distance from the foothills, gets comparatively little, and that cultivation extends the desert to the leeward (eastward in North America, westward in Africa). Fortunately for the latter, the Dutch farmers are not much addicted to broadening their wheat fields.

Where the mountain ranges run east and west, as in Asia, the tendency of the deserts, the Great and Little Gobi and others, is to extend northward.

What does it matter whether we have everywhere completed the process or in how many places it is only partially consummated? One cares not whether he is fully and technically right in calling our thinly-grassed prairie a desert. One's aim is to stop the process while yet there is time. Our salvation can come only from cattle, barnyard manure and small farms. For these the only foundation is water. Our choice is between wheat farming with its inevitable results already so dire in Saskatchewan and a radical change in our way of life. It is not the object of these letters to parcel out the blame which we must all share, but to suggest what can and what cannot be done.

Not only in the ruins of Tadmor, but as well in scores of other cities in pronounced deserts, in Syria and Asia Minor, India and Turkestan, in Persia, Africa and Mongolia, sometimes in areas not classed as pronounced deserts but, like Calgary, on their borders, has the sacrifice of timber and ruthless cultivation pulverized the soil, dried up the moisture and given scope to the wind. Our archaeologists are now busy in satisfying their curiosity concerning the habits and doings of the ancient inhabitants of once-proud cities. These savants seem strangely indifferent to what turned into deserts

countries which must have once been fertile, or there would have been no prosperous cities there. An account in detail of the different steps in the process and the time taken—wide cultivations, the sacrifice of the forest, then drought and soil-drifting, then sand-drifting and the abandonment of the farms, next the desertion of the city, finally the burial of its ruins—would be interesting and instructive. We actually know only the original state of some of these lands and their present condition. Joshua's spies found Canaan a land "flowing with milk and honey." A vista of barren and rocky hills devoid alike of trees, soil and moisture, now opens before the pious pilgrim on his way through a sterile land to the holy but squalid shrines of our faith.

We endeavour to apply the lessons of other lands to our own, and they are these: If level and heated plains intervene, the relatively hot air will hold the moisture until it meets areas of cold air elsewhere. If, as some say, our rain comes from the Pacific, the Selkirks and Rockies capture it; if from the Great Lakes or the Gulf of Mexico, as others declare, the warm air of the great plains in the continental summer renders the rainfall both uncertain and meagre after June. The essence of the whole matter is that we are not now submitting to something exceptional, but are living in a region where, from the configuration of our own, and the lessons of other continents a meagre rainfall will normally be our portion. We are far from saying that cyclonic storms or moisture-laden winds from the Great Lakes region, or possibly from the Gulf, do not at times bring copious rains to our steppe area. But the normal condition is as stated. For a short interval to the north of the Prince Albert, Saskatoon, Wainwright and Stettler line there is an area getting ten inches of rainfall, but northwards this is succeeded by a gradually lower rainfall from nine down to six. The official map and the text accompanying it, confirms this and says that the "northern stretches of all three provinces have a meagre supply of moisture."

For our own province of Saskatchewan, we are yet in time to keep for the most part our grassy plain, if we will but earnestly take now the needful steps. It is

not only a question of the rescue of thousands of our farmers from the slow agony of poverty and destitution in their old age, but of saving our beautiful prairies from the clutches of a devouring desert. The reports from our neighbors to the south are too numerous and too specific to allow us to doubt that their part of the grassy plain has, by reckless wheat farming, been turned into an area of drifting sand dunes and vanishing water supplies. Part of it has travelled in the skies as far as the Atlantic Ocean. Dust storms from the prairies darkened the noon-day sun at Washington some weeks ago. The soil deposited on the grass they eat is killing horses in Wisconsin, itself largely outside the dry belt. For that matter, some have been killed at Macleod. Photographs have been recently published of farm buildings in Saskatchewan, all covered with drifted soil except the roofs.

No doubt a long period was required to submerge the Old World savannahs, where men had crotched tree limbs for ploughs and bundles of brush for harrows, or even where, as in eastern North America, the walking plough and wooden harrows enabled a man and team to plow at most an acre per day and seed five.

But not so ours. We are progressive. We tear up the prairie sward at fifteen acres per day and a single man now boasts that, unassisted, he has pulverized, sown (and not as part of his boast), made ready for soil drifting, five, six or even seven hundred acres in the planting season.

It will not therefore take centuries to consummate the desolation of our thinly-sodded plains. Like John Gilpin's hat and wig, "we are upon the road."

VI

DESERT ORIGINS

The first edition of this booklet was published in 1934 and its title came, it is said, as a shock to many, and to others, as they kindly declared, an enlightenment. Be that as it may, it had then only the unsupported view of the writer that in a semi-arid land with twenty inches of annual rainfall or less, continuous grain-cropping would make and had made, deserts. The writer, it is true, had seen deserts in the Old World, but had then only his unsubstantiated beliefs that America was actually making them and that the process was under way in Canada as well.

No apology, then, is offered for the somewhat full selections from three writers who have had fuller opportunities of studying the effects of such cropping in the sub-humid regions of both worlds. The writer, if the personal note can be excused, gains little satisfaction from finding his deductions verified and still less from learning that the process can be swifter than he supposed. If our governments and our grain farmers can be led, by what these writers say, to follow different methods and a new way of life, albeit one more laborious, the writer will be more than content to give them all the credit.

"Man-Made Deserts," by Dr. W. C. Lowdermilk in the *Journal of the Institute of Pacific Affairs* (Volume VIII, 129 East 52nd St., New York.).

MAN-MADE DESERTS

DR. W. C. LOWDERMILK

The history of civilizations is a record of struggles against the progressive desiccation of civilized lands. The more ancient the civilization, the drier and more wasted, usually, is the supporting country. In fact, so devastating seems the occupation of man that, with a few striking exceptions, a desert or near-desert condition is often associated with his long habitation of a region. Two major factors are believed to account for the growth of man-made deserts. In the first place, semi-arid to semi-humid regions proved the most favourable sites for the early development of human culture. Such

areas, however, stand in a condition of delicate ecological balance between humid and true desert climates. Comparatively slight disturbances of the cover of vegetation and soils, such as are brought about by human occupation for grazing and cultivation, are sufficient to extend the borders of the desert far beyond the natural true desert into more humid climates.

Recently the archaeologists have turned back the pages of history, not merely centuries, but thousands of years. Their post-mortems on buried civilizations suggest that it has been the hand of man, more than climatic change which has reduced once rich and populous regions to desolation and poverty. After a long struggle, a civilization either died or its people migrated to more productive regions. Many ancient civilizations, once revelling in a golden age of prosperity, are crumbling in ruins or lie buried in sands and debris, largely caused by the destructive treatment of the lands on which they were dependent for sustenance. If modern peoples are to escape a similar fate by man-induced impoverishment and the desiccation of their lands, it would seem well to take a measure of these destructive processes and forces, and by intelligent land planning and land use provide for the sustained productivity of agricultural lands and the protection of grass lands and forests for food, textiles, raw materials and continued water supply.

It is evident that climatic changes have occurred in the past and are still in progress. Such changes follow the pace of land movements and are comparatively slow in terms of human history. Superimposed upon them there may be a rapid growth of human populations, and their activity, as well as that of their herds, which can produce increased desiccation equivalent in effect to changes of climate. It becomes important to discover how far human occupation is rendering the earth less habitable and at the same time to discover means by which such processes of deterioration may be held in check and productivity sustained. It is possible for man and his animals to render regions uninhabitable, especially in zones of delicate ecological balance between humid and true desert climates. Man-made deserts may extend from semi-arid climates to humid climates under certain conditions. In the light of this conception, of man-induced desiccation, it is in place to examine what is now known about the results of human occupation, in the way of increasing aridity due to destruction of vegetative cover, and how these desert conditions are rapidly being brought about in various areas throughout the world.

According to archaeologists the Sahara, the Central Asian deserts, the arid parts of Palestine, Mesopotamia and the Gobi and North China were once teeming with human life. The traditions of peoples descended from ancient cultures tell of immigration to their present habitation from what are now the desert regions of Central Asia. The origin of the European peoples was in the East. The Hindus came from the north, the Chinese from the west. Yet this land from which they came is to-day an immense desert where only very limited regions are still able to nourish a scanty population. Sir Aurel Stein's discoveries of sand-buried ruins in Chinese Turkestan

reveal numerous towns a square mile or more in size, in a region now depopulated. There were ruins of cities, castles, aqueducts, reservoirs and all the other evidences of lost cultures, of vanished populations. Gibbon declared that 500 cities once flourished in what are now the dry depopulated plains of Asia Minor. The recently discovered ruin of Tepe Gawra in northern Mesopotamia is claimed to be the oldest remaining town in the world. The ruins show that in B.C. 3700 this was a well-planned city, which must have represented long ages of prior development. The peninsula of Arabia contained an enormous population, called Sealand, which at times annoyed Babylon from B.C. 2500 to 616. Now, a few fierce nomadic Bedouins, the remnants of former cultures, fight for existence over every drop of water and every sign of vegetation. The great Sahara Desert has recently revealed monuments, ruins of cities, temples, implements and unearthed cut trees. Campallion, the famous Egyptologist, says of it "and so the astonishing fact dawns upon us that this desert was once a region of groves and foundations and the abode of happy millions." The very gradual climatic changes due to the present age of retreating ice do not appear sufficient to account for the excessively rapid desiccation of the vast areas known to have sustained at one time enormous populations.

We have a written record of encroaching deserts. When Zenobia was overthrown by the Romans under Aurelian, its capital, Palmyra or Tadmor, was the metropolis of a mighty empire. Now the sands of the Syrian desert almost hide the ruins of that stupendous city of marble and gold. As late as the rise of Mohammed, Tripoli, on the northern coast of Africa, had a population of six million. It was then clothed with vineyards, orchards and forests. It is now bare of vegetation. The streams are dried up and the population reduced to about forty-five thousand. Archaeologists now claim to have discovered, under shifting sands, the capital of the rich kingdom of the Queen of Sheba.

To the United States, doubtless, goes the speed record in time and extent, for man-made desert conditions. The dust storms of the old world, long occupied by man, have appeared in the new world—and for the same reasons. Great dust clouds obscuring the sun at midday swept out of the western plains eastward to the Atlantic seaboard for the first time in May, 1934. Over large areas, in the central and southwest plains, every living thing choked in the dust-filled atmosphere. Pasture vegetation was coated with dust and made inedible for stock. Fields were turned into sand dunes. It has been a tragic experience, but it is the price that a whole nation is paying for the rapid exploitation of its prairie grazing lands about the close of the war. For centuries, nature had anchored these soils with a thick sod of buffalo or native grasses. Then came the war boom and high prices, which stimulated the ploughing up of millions of acres of the western grass lands. Grazing lands were attacked with tractor-drawn ploughs. The rich humus soils first yielded abundant crops. Rains were plentiful. The same crops were planted year after year. (Canada now disputes this honor with the States.)

Then came the drought. The soil-binding quality of the humus had been depleted by continuous cropping. The stubble of poor, unharvested crops was pastured by livestock. The ground was pulverized by their hoofs. The usual strong winds began to blow in the spring. They were dry, and there was no vegetation nor roots to anchor the soils, which were blown aloft in the upper wind currents to form gigantic dust clouds. The machine-like sorting process of wind erosion began. Fine and fertile particles were blown to parts unknown and the heavy material was left behind as drifts or hummocks forming sand dunes, some of them twenty feet high. Since May, 1934, wind erosion, set in motion by man-made forces, has transformed 5,000,000 acres of formerly good land into waste areas and great stretches of sand dunes. More than 60,000,000 acres more are in the process of wind erosion destruction by the same cause and will follow the desert condition of the 5,000,000 destroyed acres, unless adequate control methods are undertaken.

We boast of a modern civilization and its progress, but we have been following suicidal methods in treatment of soil resources. With high-powered implements we have been rapidly destroying the vegetation and forests, with the resulting loss of productive soils and increasing desiccation. Whether ancient or modern, the destruction of vegetation on sloping lands, by whatever cause, exposes fertile soils to wind and water erosion so that the soils are destroyed greatly in excess of soil formation, until a complete destruction of fertility is accomplished. The capacity of humus soils as reservoirs to conserve rain and snow waters is thus reduced, so that springs and streams dry up. With percolation much reduced on denuded slopes, rain waters concentrate to form destructive gullies, which further destroy land utility. An old writer asserts that "the skin of the animal is not more necessary to its wellbeing than is the vegetative cover of the earth essential to the proper condition of the soil."

But it is not necessary for mankind to destroy the good earth upon which he is dependent for sustenance. Some primitive peoples have discovered means of conserving soils. Ideas of conservation on a national scale, however, have been conceived only in recent times. It seems clear that man and his animals may extend desert conditions by processes of man-induced desiccation, into regions formerly capable of supporting large populations. Climate does change, but not at the comparatively rapid rate of the decadence of vast areas of habitable regions. Experimental studies within the past two decades in the character and degree of acceleration of erosion, above the normal rates of geologic processes, have given a better understanding of how deserts may be man-made. With this understanding there may be worked out and put into effect measures adequate to the conservation of soil resources and with them moisture, and therewith a restoration of vegetation, suitable crops, and grass and forests. The lands of the earth are occupied; frontiers of new lands have disappeared. The only new frontier that now remains is underfoot, in the maintenance of productivity of lands now occupied.

VII

SOILS

The soil of our Plains sustains almost wholly our economic life. Nature gives niggardly the water for its thirst; we deny it food to appease its hunger. The winds attack it and in clouds of dust they carry it away. One of its chief enemies, ourselves, we leave it open to its others. Shall we not instead study how to treat it justly and thus help it overcome, as far as may be, its other adversaries.

Soils the world over have the same fundamental origin. Everywhere the dark surface soil is mainly decayed vegetable matter and, to a lesser extent, the remains of animal life.

Below this is a greyish soil of decomposed rock. It contains in large or small quantities down to the merest traces, all the mineral elements that chemistry has identified.

In the atmosphere is a gas of the greatest importance, nitrogen. Of all these elements, three, nitrogen, phosphorus and potassium, are absolutely essential to both animal and vegetable growth and in a general way they, only, claim the farmer's attention or at times cause him anxieties. Nitrogen, not a mineral, is inexhaustible in the air, is averse from union with the soil and is rapidly consumed by cropping and blown away when the soil drifts, but in most regions it has been freely taken from the air and placed in our soils through the growth of wild legumes. Upon cultivation, domestic legumes become still more efficient in this. The other two essentials, phosphorus and potassium, cannot be added to the soil except by purchase and their exhaustion begins with the first crop sold off the farm. From grain, hay and straw fed to animals a very substantial part is recovered. But the amount taken and sold in the grain at the elevator from any one crop, is small and the supply in most soils will last for very many years. Still their exhaustion is only a matter of time.

Certain other minerals are required for plant growth;

iron (there cannot be a green leaf or a green blade of grass without it), sulphur, boron (borax), magnesium, sodium, manganese and calcium (lime, required to correct acidity but not a plant food). Very small amounts of these are necessary and generally are not lacking.

But though of different origins, the vegetable, animal and mineral potential plant food are intermingled in the dark surface layer of soil especially after cultivation.

Now these mineral plant foods are always plentiful in arid or semi-arid lands. Deserts have the most; the moon has them in profusion. It is because they are not washed down out of our reach or carried down to the sea by our sparse rainfall as happens in rainier regions. As our rainfall does not exceed an exiguous sixteen inches annually, we can be fairly contented with our favorable position—as to the raw mineral elements of fertility only, be it clearly understood. But the agronomists of the semi-arid regions of North America openly declare that this abundance of these elements has no interest for us. It is only the part which, with the assistance of the dark upper layer, can be converted into plant food, that matters in the least.

We revert with much less assurance to this upper layer of the soil and to its vegetable and animal components of which the loss by cropping, oxidizing (burning) and soil-drifting is not limited to the food loss.

Assuming that the ice-cap retreated from our plains about twelve or thirteen thousand years ago, we see how slowly this layer has been formed, four, five or, say, six inches in twice as many millenniums, except, of course, in the old Agassiz lake bed, where it is as many feet. Slow as was the growth of this dark organic layer, its replacement difficult and its quantity meagre, it is yet absolutely essential to proper tilth and to plant growth, for the mineral elements of whose abundance we are somewhat foolishly proud are helpless without it. It behooves us then to nurse it with extreme care. Yet for forty-five and in some localities for sixty years, we have done the very opposite.

Why is it so essential, what are its functions, why are

the plentiful mineral elements helpless of themselves to nourish plant life?

Plants take their nourishment like young infants in a liquid form only. No mother gives her young baby a slice of bread and butter; a plant can do no better with a lump of gypsum or sulphur or with iron even as the finest filings. Plants and trees are as infants throughout their lives. Their sap carries not the smallest particle of solid food; all must be dissolved. To make sure of this Nature has spread a membrane across the opening of their tiny microscopic rootlets and all nourishment for the greatest tree and the smallest plant must be strained through it.

Now both the plentiful mineral and the less plentiful vegetable elements of plant food are solids, most of them in compounds of which many are refractory and hardly any are soluble in water, not even in the water of a warm rain.

However, Nature has provided a workshop for dealing with these mineral compounds and other solids. In the dark top layer of the soil if it be reasonably provided from time to time with fresh vegetable matter or stable manure to rot or decay, there are colonies of microscopic life, bacteria, algae, yeasts, protozoa and fungi, along with earthworms and insects, all feeding upon and transforming this vegetable and animal matter. This transformation is what we call rotting.

These microscopic forms of life have the power of so acting upon the soil's elements and their compounds, some in one form, some in another, as to render them soluble in the soil's water and so drinkable by the plants. They alone have this power and it is in the fresh vegetable and animal matter alone that they live. The processes are intricate and cannot be described here. There may be and often are, more than one transmutation by successive forms of bacterial life, but in the end the substance becomes soluble. Then, and not before, is it available plant food. This is why the mineral elements of fertility are helpless of themselves to feed the plant. It is also why the agronomists say an abundance of mineral plant food means nothing of itself.

Then comes the question how to keep up the supply of rotting vegetation and manure, in order to maintain the bacterial life. The sowing and ploughing under of green crops and the saving and use of stable manure is insistently urged by all soil chemists and agronomists for the above reason and the further reason that their presence aids good tilth.

Continuous and exclusive wheat-farming provides little or no vegetable or animal matter, and in the opinion of men like Fletcher of Michigan, Hopkins of Chicago and Olin of Idaho, all professors of agriculture, it will always lead to ruin.

There is another reason why green and stable manures should be constantly used in a semi-arid region. Soils so kept up will retain from three to five times as much of our scarce and precious rainfall as soils without such treatment. There are in Canada and the United States more than one hundred soil chemists who say so. It is the destruction of the soil's water-holding capacity which has so terribly accentuated our desert conditions.

Mr. J. C. Russel, of Nebraska University Experimental Farms, goes further and doubts whether if the water-holding capacity of the virgin soil, its fibrousness and granulation, be once destroyed, it can ever be regained short of a prolonged relapse, as the writer understands his idea, into unpastured prairie.

Sixty years is the time assigned to ruin any ordinary prairie soil by the neglect of the ordinary canons of its management, including our failure to keep its workshop supplied with, so to say, its tools: and we must not be misled by statements of wonderful yields either on the old lake bed in Manitoba or by rainfalls beyond the average. That any soil will stand starvation indefinitely is to expect a repeal of the laws of mathematics. Of course if we have no concern for our children's or our country's future, our generation may still have intervals of prosperity and be content therewith.

VIII

WATER AND IRRIGATION

Probably every grown-up person and most of the youth of Canada know of the mighty rivers that flow from the Rocky Mountains across our prairies to the sea. Few know the exact quantity of water in these rivers or how it is measured, but they know that the total amount must be enormous. Then they read of the immense dams that have been built or are building in other countries, some of them thought backward or even barbaric compared with our own; Spain, Egypt, Mesopotamia, India, or nearer in states more like our prairies, Oregon, Utah, Colorado or Texas. They must wonder why, with our brimming rivers, we do not water our burning plains, and indeed, we ourselves wonder, and when we look around and find a matter of four or five small dams in all the West, and these on minor streams, we are driven to a confession that our western "enterprise" is not unlimited. What energy we have has been expended in building up the amenities, the comforts and the "desirables" of life rather than in making sure the foundation of prosperity by providing our farmers with water.

But in justice to ourselves we must go further into the matter and explain some of the problems connected with the use of water. Though we cannot exculpate ourselves entirely, yet it is only fair to set forth the facts plainly so that in whatever part of Canada they live our people may judge for themselves how far we are reasonably justified in asking for the assistance of the East and further decide upon what plan or with what object in view the assistance should be applied.

All will agree that actual distress should be alleviated with little or no regard to the faults or mistakes of the distressed. After that it is submitted that the money should be devoted to the eradication of the root causes of the distress, or, if this be impossible in some places, then to their mitigation, and most emphatically not to furnish help for the followers of wrong courses.

Let us see how much land needs irrigation in the years of average rainfall. For this we take areas which do not get an average of ten inches in the growing season. Theoretically the whole vast area of the Saskatchewan basin could be irrigated, as it all lies lower than the foothills of the Rockies whence come the snow-fed streams that finally join to form the river of that name.

Actually there are great limitations. The quantity of water, enormous as it is, is not sufficient for the whole after the waste is deducted. Areas lower than the water height at the foothills may still be higher than a depression or valley intervening. Again, water can be taken only a limited distance in artificial channels; seepage and evaporation will finally take it all. Finally a river may have cut so deep a channel for itself that it is impossible except at a disproportionate cost to raise its waters to the country level. The beds of the Saskatchewan and the Red Deer are in places 350 feet deep. Here one recognizes that, a mere layman, he is in the field of the irrigation and hydrometric engineer who must have not only the last, but also the first word on the subject. But even a layman may point out certain facts which limit the possibilities, and to point out the impossibilities may be useful.

IRRIGABLE AND NON-IRRIGABLE AREAS

We leave out for the present all reference to the waters of the Arctic Basin, the nearest rivers of which are the Pembina and the Athabasca, whose waters will in the future claim attention. Similarly at the south, the Milk River area, a part of the Missouri and Mississippi Basin, is left aside. Its waters are controlled by a commission appointed under a convention between Great Britain and the United States.

We leave aside also the Red River Basin, which includes the drainage areas of the Qu'Appelle, Assiniboine, Souris and other smaller rivers. Their waters constitute a problem different in kind from the snow-fed streams from the Rockies. The latter have in the snows of the mountains their natural reservoirs

which give out their waters most freely in hot and dry weather. The streams of the Red River basin must have artificial reservoirs if the same result is to be attained.

IRRIGATION IN SASKATCHEWAN

It may be conceded that on moral and no doubt legal grounds Saskatchewan is entitled to a fair share of the Rocky Mountain waters. It is for the present assumed that Eastern Saskatchewan is not in great need of these waters. Coming then to western Saskatchewan, if we draw a line south-east from a point on the South Saskatchewan about twenty miles below Outlook through Regina and thence to Estevan at the United States boundary, we shall have roughly the eastern boundary of the drier part of Saskatchewan east and south of the South Saskatchewan River to the Alberta border. It will contain about twenty million acres. Following as closely as possible the rain map published by the Dominion Government giving the average rainfall for thirty-five years upon our Prairie Provinces, we find that about one-half of this area generally has a rainfall of about ten inches in the growing season, April 1st to September 30th, enough, if it comes opportunely, to grow the usual grain crops. This leaves say ten million acres in Saskatchewan south of the South Saskatchewan River requiring water from artificial means in the average season. Then we encounter the difficulty of the great depth of the Saskatchewan River bed, say at the Elbow or Riverhurst, where the water would naturally be taken out for the Moose Jaw-Regina-Estevan country. Here we encounter another of the above obstacles. The western part of southern Saskatchewan is, as already stated at length, very largely occupied by the Missouri Coteau, too high to be reached by Rocky Mountain water. By the time the South Saskatchewan reaches Medicine Hat its channel is too deep to make it practically possible to put its waters on this plateau.

As no Saskatchewan river water can reach the top of this plateau obviously none can reach its southern slopes, which continue to the American border, and subject to an accurate survey its northern slopes continue at such a high level nearly to the Saskatchewan that it is extremely doubtful whether any strip of land along that river accessible to water would be of an extent which would justify the building of a huge dam to take the water up to it. The government engineers who, in 1922-23, examined the land between the North and South Saskatchewan from an irrigation point of view, reported that there were 135,000 acres south on the latter river between Leader and Cabri which might be irrigated from the South Saskatchewan. It seems entirely a question of cost in relation to the extent of land to be benefited. No doubt many will be surprised and disappointed to find that so large a part of the dry area of Saskatchewan is not open to irrigation.

It is stated that there was once under consideration the possibility of diverting the water of the South Saskatchewan at the Elbow into the valley of the head waters of the Qu'Appelle whence it might be distributed over a large part of southern Saskatchewan. There is a great valley at that point in which the Qu'Appelle now runs, looking as if at one time the South Saskatchewan had run south-east from the Elbow. It certainly seems out of proportion for the tiny stream of the Qu'Appelle, and when the writer first saw it, it bore all the marks of the valley of a large river and not of a mere trough or fold of the ground. How high the valley bed was above the present bed of the Saskatchewan was not then looked into. An examination of the map's contours makes this valley about one hundred feet higher than the present bed of the Saskatchewan River, though some think it less.

It may be that water could be taken out of the South Saskatchewan at the Elbow in the ordinary way, but if taken north-east it would be towards a region with, generally speaking, enough rain. On the other hand,

if the old river bed could be made use of by a dam across the river just below it, then the whole Qu'Appelle valley, Buffalo Lake, the Fishing Lakes and eastward could be turned into an immense reservoir for south-eastern Saskatchewan and western Manitoba. No opinion is here expressed as to the feasibility of this. It would be costly, yet the money now expending for relief without any real result would be ample for the purpose.

A plan has recently been mooted for taking out water at Riverhurst, a point on the Saskatchewan above the Elbow seventy miles due north-west of Moose Jaw. It is thought that by this, a strip of country could be watered about forty miles wide extending south-easterly to Estevan, Alameda and Oxbow and comprising 8,500 square miles or 1,980,000 acres. It is practically the same as the above Elbow-Aitkow Creek scheme. There is at present ample water for this in the river.

There remains of the dry area of Saskatchewan the region between the North and South Saskatchewan, or more accurately the region bounded on the north by the Battle River and the North Saskatchewan and on the east and south by the Red Deer and South Saskatchewan. Its total area in Saskatchewan is about 13,500,000 acres, in Alberta, 6,600,000. It was the opinion of the late Mr. William Pearce, C.E., that with certain minor exceptions it could be all "watered" as distinguished from "irrigated." His proposals are generally referred to as the Pearce Plan. As it included about 3,500,000 acres in Alberta it will be more fully described below.

IRRIGATION IN ALBERTA

Alberta is much better situated than her sister province. Besides being nearer the sources of the water it may be said, subject to surveys in detail, that nearly the whole of her dry area lies low enough to be reached by water. The following are rough estimates for the different areas, though in some parts the necessary expense might not be thought justifiable, for example the south-eastern Alberta 4,606,000 acres.

IRRIGABLE AREAS

	ACRES
Hanna Youngstown area	6,000,000
Three Hills Beiseker area	900,000
East Tilley	1,500,000
South-east Alberta	4,606,000
C.P.R. E. and W. Sections (now irrigated)	468,000
Total in Alberta	13,474,980
Total in Saskatchewan	13,500,000
Total of both	26,974,980
If Riverhurst plan practicable	1,980,000
Grand Total	28,954,980

The above, it must be understood, is an estimate only from the ordinary contour maps. On account of elevations and other difficulties of access which only detailed examinations would show, probably 20,000,000 acres would be nearer the mark. From the following pages it will be seen that any attempt at greater accuracy would be useless labor.

We come now to consider the crucial question, how much water is available?

Here we must be somewhat technical though in as simple a way as possible. There are two ways of expressing in figures the quantity of water that flows in a river, its "run off" in the language of the irrigation people. By one system it is expressed by stating the number of cubic feet that flow past a given point in a second and is stated shortly as so many "cubic feet per second," or "cusecs."

The other way, that used herein, is to say what area of land would be covered by the river's flow to a given depth in a given time. An acre is generally taken as the area, one foot as the depth and twelve months as the time. That is, the unit of measurement is the quantity of water that would cover an acre twelve inches deep, and when the number of acres so covered is mentioned as a river's flow (run-off) a year's flow is understood. As an acre is 43,560 square feet, an acre foot will be 43,560 cubic feet of water. This huge quantity of

water is called "an acre foot." The flow of the Bow River (its run-off) at Calgary is 2,590,000 acre feet, so the water which runs say under the Calgary bridges in twelve months, would cover 2,590,000 acres of land a foot deep. Sometimes the books give the flow in cusecs and it may be a convenience to know how to turn these "cusec" figures into acre feet figures.

Now it is a fortunate accident that the square feet in two acres, 87,120, is very nearly the same as the seconds in 24 hours, 86,400. A flow of one cubic foot per second would be 86,400 cubic feet in twenty-four hours, which would cover two acres within a fraction (1.98 acres to be exact). Therefore half the flow in cubic feet per second (cu-secs) will be the number of acres which will be covered 12 inches deep in 24 hours. This multiplied by 365 will be what is called the flow of the stream in acre feet. Unless one takes a little trouble to figure this out for himself it is almost useless for him to attempt to understand water and irrigation matters.

Now if there be no rain at all, grain crops will not grow with much less than twelve inches of water distributed, of course, through the growing season, though eighteen inches is generally fixed as the water "duty" when water is allotted by the government for an irrigation scheme. As we nearly always have some rain, it is proposed to take twelve inches as sufficient in our case.

It may not be out of place to correct here a common impression regarding the value of winter precipitation. It is the authoritative opinion of government and other responsible engineers, that it has no value. Vide Report on Irrigation (*Canada*, 1913, p. 49) Report of Mr. Turner Bone, C.E., which says:

"It is to be accepted as a truth that snow and other precipitation which occurs during the winter months are of no value for agriculture because it either runs off the frozen surface of the ground or is dissipated into the air by the warm chinook winds."

The following table shows in acre feet the total *annual* flow or run-off of the rivers named which from

south to north are the mountain rivers which finally unite to form the Saskatchewan.

	ACRE FEET
Tributaries of the Old Man River	
St. Mary River...	647,000
Belly River.....	869,000
The Old Man River at Lethbridge.....	2,590,000
(The Bow River at Calgary..... 2,570,000)	
Bow River at Bassano.....	3,270,000
<hr/>	
Total of Bow and Old Man which unite near Bow Island to make the South Saskatchewan.....	5,860,000
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The South Saskatchewan at Medicine Hat.....	5,890,000
The Red Deer at Empress.....	1,540,000
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Total run-off at Empress (South Saskatchewan).....	7,430,000
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South Saskatchewan at Saskatoon or Riverhurst.....	8,100,000
North Saskatchewan at Rocky Mountain House.....	3,780,000
North Saskatchewan at Prince Albert.....	6,930,000

No figures are available for river flows below Saskatoon and Prince Albert, and, generally speaking, the country below these places does not need irrigation at present. It is problematical whether it is really useful to take account of the quantity in the South Saskatchewan below Riverhurst, for, as indicated above, it would be most difficult to use it and perhaps so costly as to be prohibitive. For example, the bed of the South Saskatchewan from Saskatchewan Landing to Riverhurst township, 23 Range, 7 West, 73rd Meridian, is generally from 200 to 250 feet and in some places 350 feet below the country level. The Red Deer gorge at and below Drumheller is at least as deep. As the country through which the North Saskatchewan runs is not generally in need of irrigation it is not much use to consider that river's run-off below Rocky Mountain House. Rocky Mountain House is taken because it is from that point the Pearce Plan proposes to take the North Saskatchewan waters. If there are any plans on foot to use this water at Edmonton, Battleford or

Prince Albert, they have escaped the writer's notice. So we take the run-off at the following points.

	ACRE FEET
South Saskatchewan at Riverhurst.....	8,100,000
North Saskatchewan at Rocky Mountain House.....	3,780,000
Total run-off to be taken into account.....	11,880,000

Even this total of available water is subject to what the engineers and the governments concerned decide as to the use of the South Saskatchewan water below Medicine Hat. Then several subsidiary but important considerations remain.

1. About fifteen per cent of the mountain waters flows in the non-using season, October to March inclusive. As we have no storage basins, no reservoirs, this is all lost. Now it is well known that there are suitable sites for these in our foothills and valleys, but their location, extent and capacity has not been definitely fixed. The foothill ridges run parallel to the mountain range; our rivers run at right angles to these ridges. In the course of centuries the streams have broken or worn their way through the ridges or found their way around them at their broken ends. At these gaps it would be necessary to build very short dams only in order to turn the valleys above them into immense lakes; in other places, longer dams, of course. By this means, much of the winter water could be saved for use in summer. No irrigation or water using system worthy of the name can fulfil its functions to the full extent without them. Canada is the only civilized country needing and lacking them. In the meantime when making our calculations we must deduct fifteen per cent from the measured supply as the winter flow.

2. The loss in canals from seepage, evaporation and careless waste has a wide range, given by the authorities as from thirty to seventy per cent. In short main canals with clayey banks, in cool weather thirty per cent might cover the loss. The longer the ditch, the more porous its bottom and sides, the hotter the weather and the greater the carelessness and waste of the users,

the greater the loss, naturally. On these accounts we cannot reckon on less than a forty per cent loss of the summer water, the only water we can have without storage basins.

On the other hand there is no part of the dry area which on the thirty-five-year average has less than six inches of rain in the summer. Deducting first fifteen per cent running to waste in the winter and forty per cent of the remainder for losses in the canals and over irrigation we have left 6,588,000 acre feet available on the actual land.

Then the question arises how best to use on the twenty million acres the water which by normal irrigation methods will suffice for 6,588,000 acres only. To rely on a modicum of six or seven inches of rain and to spread the 6,588,000 acre feet over ten or eleven million acres might often result in a useless amount of water everywhere.

If the normal amount, say twelve inches, is to be concentrated on certain areas, what principle is to guide us in the selection of the favored localities? The writer cannot pretend to answer the question.

Now we have so far spoken as if it were understood that the water we have would, as a matter of course, be used in irrigation. But before going further there is a question which has been forcing itself upon the attention of all students of our farm problems. It arises out of certain puzzling facts which seem to throw doubt on the wisdom of troubling ourselves further about irrigation in the ordinary sense of the word and for the present generation, unless indeed there is the change of heart elsewhere spoken of, followed by a change of methods—things which do not happen overnight.

There are twelve irrigation areas in southern Alberta all on the Bow or Old Man Rivers or their tributaries. Their total irrigable area is 886,746 acres. They have been allotted by the government eighteen inches of water for every square foot, $1\frac{1}{2}$ acre feet for every acre, which by the way would consume 1,329,869 out of our 6,588,000 acre feet. Yet only 338,509 acres, thirty-eight per cent, were irrigated in 1935 as shown by the

following table taken from an Alberta government statement concerning the irrigation projects in operation at the beginning of 1936. The areas and quantities are stated to be approximate only. Referring to the deductions spoken of on a preceding page to be made from the total flow of water to arrive at the quantity left for actual use on the field, the irrigation authorities of Alberta allow the owners to take from the streams a very liberal allowance to cover waste and evaporation, even in some cases to ninety per cent above the one and a half acre feet normally sanctioned. This concession does no harm as things are, but if our supply should ever come to be more generally used we should have to be more frugal.

IRRIGATION PROJECTS IN ALBERTA IN OPERATION
AT DECEMBER 31, 1935

IRRIGATION DISTRICTS	IRRI- GABLE ACREAGE	AREA IRRIGA- TION DURING 1935	WATER DIVERTED FROM
Lethbridge Northern.....	98,769	62,416	Old Man River
Taber.....	21,499	18,854	St. Mary River through C.P. R. Lethbridge system.
United.....	34,167	10,500	Belly River
New West.....	4,564	1,691	Bow River
Magrath.....	6,975	4,000	St. Mary River
Raymond.....	15,130	12,000	St. Mary River
Mountain View.....	3,569	1,168	Belly River
Little Bow.....	3,093	300	Highwood River
C.P.R. Western Section.....	218,980	40,812	Bow River
C.P.R. Eastern Section.....	250,000	96,019	Bow River
C.P.R. Lethbridge Section....	100,000	70,000	St. Mary River
Canada Land & Irrigation Co..	130,000	20,749	Bow River
Totals.....	886,746	338,509	

The percentage of irrigable land actually watered, as the table shows, varies from 87 per cent at Taber, 80 per cent at Raymond, 70 per cent in the C.P.R. Lethbridge district and 63 per cent in the Lethbridge Northern area to 10 per cent in a certain district. The

two largest districts, one with 219,000, the other with 250,000 acres, are irrigated to the extent of 41,000 and 96,000 acres only, that is, 18 and 38 per cent respectively.

A more general use of the water, therefore, is made in the more southerly districts where the sugar-beet is grown with the labor done by European immigrants or people from Utah who are not averse to hard work, and much less in the northerly areas. Yet one large district of 130,000 acres lying fairly well to the south and east was irrigated in 1933 to the extent of 21,000 acres, sixteen per cent only. There may, of course, be some explanation of this not disclosed by the government figures, but taking these irrigation districts altogether it must be recognized that we are not taking advantage of the water which at great expense has already been brought on the land.

The explanation as to the C.P.R. western or Calgary block is probably that the average rainfall is generally sufficient for a fair crop with not infrequent failures, and the farmers therefore prefer their chance of this to the downright hard manual labor of irrigating their fields, shovel in hand. Their farms run from 160 to 2,000 acres or more, and the area which a farmer with one employed man, or say two young sons, could irrigate does not exceed eighty acres. But one man alone can machine farm four hundred acres, and indeed very much more, quite easily, and in these districts he is generally equipped with and has to pay or has paid for the necessary machinery. So up to the present he has found no attraction in more modest aims and more laborious methods.

Speaking more generally, there are several reasons for the comparative, we cannot say failure, because irrigation in a dry country cannot be a failure, but for the comparative non-use and neglect of our present irrigated areas.

1. Our growing season is so short that only one crop can be grown in the season. In the case where this one crop can with intensive labor be made to yield a very large return per acre, irrigation can be successful, but with the ordinary grain crops this is not the case.

2. Labor costs are too high where the cultivation of half or whole sections or more is aimed at. In most of the countries where irrigation has been carried on extensively labor is cheap, the laborer's wages running from twenty-five to fifty cents per day and often much less.

3. There is no market except for a limited amount of garden produce, and our rural population is not yet seized of the idea of the true farmer's way of life. Irrigation can succeed to a limited extent in the vicinity of large centres of population. If we had two or three cities from one to two million inhabitants each there would be a market for the produce which can be grown by intensive cultivation on small areas with abundant water.

4. The habits of our farm population are now and have been from the beginning of the settlement of our western plains entirely at variance with the irrigation idea and the modes and ways of life that go with it.

5. A fifth cause, one susceptible of removal, is that irrigation often brings alkalis, some pernicious, some not, to the surface, or if not to the surface, yet up to the region of the plant roots. These alkalis (salts) are the chlorides, carbonates and sulphates of the beneficial mineral elements in our soils which in other chemical combinations constitute part of its fertility. In semi-arid regions the scanty rainfall is enough to cause the formation of soluble mineral salts, but not sufficient to remove them by natural drainage. The process is simple. The irrigation water (often too liberally used) unites with these elements and the surplus of the resulting solutions is not properly or effectually drained off (the idea being prevalent that in no case is drainage necessary on our dry prairies). It rises to the surface on evaporation, carrying up these salts with it; the water goes into the air, leaving the solid matter on or near the surface. They do not so much poison as choke the plant, although some really do poison it. Proper drainage is the simple, though not always an easy, remedy. Some sub-soils are so porous as not to need

drainage, as in the beetroot country at and near Lethbridge.

If one wishes to see for himself how alkalis are brought to the surface and how it can be prevented, an experiment can easily be made. Take two ordinary flower pots carefully closing the drain opening of one, but not the other. Mix a tablespoonful of Glauber's salts (an alkali), procurable for a few cents at any drug store, with fair garden soil in the proportion of 50 of earth to 1 of alkali, making the pot say three-quarters full. Then fill to the top with water as in over-irrigation and put them out in the air and sun, or in winter in a dry cellar, until the earth has entirely dried out. The water in the corked pot can escape by evaporation only and the alkali coming up in solution in the water is left white and dry on the surface. The water in the other pot will, of course, drain away through the open hole in the bottom, carrying the alkali with it.

The word "alkali" is itself a general term for various salts; Epsom, Glauber's, common table salt, washing soda, bitter salts, etc. The experiment can be tried with any of them, but washing soda will produce black alkali (very pernicious) which will not be easy to distinguish from the black soil itself. The proper method to avoid trouble with these salts would seem to be, unless the natural or artificial drainage is good, to use only what water is absolutely necessary. In some soils there are no pernicious alkalis. In hollows with no drainage possible and a hard-pan below, the position resembles the corked flower pot.

Reverting after this digression to the general irrigation question, it seems that, whatever the reasons, it is not unreasonable to say that irrigation has not taken a strong hold on our farmers, and for the present a discussion upon the apportionment of water for that purpose on the prairies is largely futile.

One of the areas to which the late Mr. Pearce would apply his plan was that part of the Saskatchewan basin lying between the north and south branches of that river. It would be the country lying below and east of the 2,500 feet contour which runs from the junction

of the Bull Pound Creek with the Red Deer, hence north and a little east, thence north-west and south of the Battle River to Buffalo Lake. There would be "watered," it is thought, 3,500,000 acres in Alberta and 13,500,000 in Saskatchewan.

However, it will be fairer and also more convincing to quote in part this eminent engineer's own words.

I have made a study of the data on the contour maps for Alberta and Saskatchewan issued by the Irrigation Branch of the Department of Interior, intitled "Map showing land forms."

I enclose with this a copy of a sketch illustrating the proposition in Southern Alberta, showing in a broken line what, from the said contour maps, I think would probably be the route of a canal to take water out of the Saskatchewan River and store it in Buffalo Lake.

It might be well to recite that my view of the scheme is not immediately an irrigation proposition; rather having in view the possibilities of making a very large area bounded on the south by the Red Deer and South Saskatchewan Rivers; on the east by the South Saskatchewan; on the north by the North Saskatchewan and Battle Rivers and on the west approximately the 2,500 foot contour; (see sketch) attractive for stock-raising by supplying every draw, creek, channel or ravine, so that they will carry a bountiful supply of water for stock-watering and drinking purposes during a large portion of the year and for cheap storage during the rest. In addition there would be a very large area lying along and under the canal leading from the Saskatchewan River to Buffalo Lake which could profitably be irrigated from said canal for the purpose of growing forage.

Such a scheme would at once make this section an ideal stock country and could then be utilized for what probably would support the greatest possible population and the largest output, namely, devoting it to dairying, at the same time maintaining, in fact increasing, its grain outputs.

Having these living streams all over the country the settlers in turn could divert them and grow a plentiful supply of forage consisting of hay and vegetables, thereby through manure fertilization maintaining the soil in such condition that it will not be destroyed by the winds, a result now so evident.

It is a question for consideration whether a scheme of this nature, started in the immediate future, would not supply labour which, owing to the return of soldiers and other causes, may require very serious consideration.

In 1922 and 1923 the Dominion government caused preliminary surveys to be made of the area in question. The results are to be found in the Annual Report, 1924,

of the Reclamation Service of the Department of the Interior for the above years. It is perhaps unfortunate that the survey parties appear to have had in mind an irrigation project only. The report contains a map showing the lands which, at a price, could be irrigated, a total of 1,410,980 acres. These, of course, are only a fractional part of the 18,000,000 acres which the late Mr. Pearce found could be served, not as an irrigation project, but as a mixed farming plan.

The report states that it was not possible to make a detailed statement of the cost, but that to irrigate a certain 427,360 acres therein specified, the cost would probably be about \$23,504,800.00, or \$55.00 per acre. Now if this cost were spread over the 18,000,000 acres the cost would be \$1.20 per acre, it being assumed that the cost of the scheme for filling up lakes, sloughs, ponds and having the water run down the draws and stream beds now dry to make water available for the mixed farmer on 18,000,000, would not be more than the cost of a complete irrigation scheme for the above 427,360 acres. Here again one speaks with the greatest hesitation on a matter which is one for engineers from first to last. Still the engineers consulted by the writer agree. On the other hand the alternative is a desertion of the area or hopeless attempts to continue grain farming there. If our prairies can be saved from the desert only by the mixed farmer, a thesis these pages are written solely to maintain, he must get more water in some way, even if he has made great mistakes and has not done as much as he could have done to get and save it.

Affecting two provinces, the Pearce Plan would be a joint enterprise, and as things are at present the aid of the federal government would be needed. It would cost a good deal, but the figure of \$30,000,000 is perhaps excessive. Still it would cost a lot of money but the alternative is too disheartening to contemplate. Eighteen million acres, still in grass for the greater part, to be abandoned for lack of water for the farmer's cattle or even for household use.

There is, moreover, no reason why the plan should

not be applied to every river coming from the mountains and now flowing into Hudson Bay.

One does not attempt to pronounce upon either the cost or the feasibility of this proposal, but the bare facts themselves demand attention; 56,000,000 tons of water, nearly 11,000,000,000 gallons, rushing by in our rivers day by day and every day, while the land is abandoned for the want of it. Mr. Pearce's idea evidently was that a great population of mixed farmers would be better for the manufacturing and mercantile interests and the country generally than a much less number of grain farmers (each with from 300 to 2,000 acres) reduced to penury from want of water. It demands the serious attention of these interests of Eastern Canada. The Dominion as a whole—and it is idle to minimize the truth that by far the greater part of the contribution is from the East—is pouring money in millions into the West for the relief there of farmers—156,000 in 1935. (Vide speech of Mr. Rogers, Minister of Labor, in the House of Commons, May, 1936.)

These all claim that the lack of water is the cause of the failure. Would the East not be wiser to spend the money in work that would provide it?

The writer, conscious of the little weight to be allowed to his opinions apart from the facts adduced, still ventures to urge upon our governments a consideration of the fate of the many semi-arid regions of the world situated exactly as ours.

The Pearce Plan may be impracticable or too costly, but the plains need the mountain waters and as the years go by will clamor for them more insistently. No country but our own pretends an indifference to or a superiority over such necessities.

IX

TYPES OF SOIL CULTIVATORS

A good deal has been said about the aims and methods of those who follow the diverse ways of farming. These diversities are great: they range from the Armenian or Anatolian, who ploughs with a tree crotch or its equivalent, one prong possibly iron shod, to the tractor and nine-beam machine of the prairies of the New World; the terrain, too, varies even more widely, from Saharan oases or lean stony Scottish hillsides to the vast and fertile plains where the furrows of the ploughman are lost to sight in the distance. The difference in habits, in the exertions required, in the hours and months of labor, in the leisure hours and in the amenities enjoyed, are so great that as one turns from one class to another one seems to be speaking of the inhabitants of different worlds.

Yet their aim is universally the same—to win from the often reluctant soil the needs of life. Their overmastering necessity is also identical, to preserve the strength and crop-yielding condition of their lands from year to year, and, unless a people, as in western America, gives itself up to soil devastation for the sake of the present, they strive to preserve its quality from generation to generation. A survey of farm life in its differing environments offers a tempting field of inquiry, and a natural division seems to be, first, the nomad of the steppe and the desert whose essays in agriculture are desultory at the best; the more sedentary peasant of the like regions; the peasant or farmer both of the humid lands of the earth and of its semi-arid regions, and finally the farmer of the single-grain crop whose favorite habitat is the treeless plains.

THE NOMADS

The people who are purely nomadic and live by their flocks and herds are pastoral, shepherds not farmers, and so are really outside our purview. But many of them

combine a limited amount of crop, fruit and garden industry in valleys with the pasturing of their herds on the dry hillside and plateaux or on the herbage of the desert plains.

This class need not detain us long, yet we can draw a lesson from its life. The inhabitants of all deserts have developed through many centuries their own technique of living. It can be done, and we, too, must do it if we are to live. It is, no doubt, a special art and its followers cannot always live in such a style as they may fancy or desire. It may be an anxious and arduous life, a life of unremitting care and vigilance and even in some countries of danger.

The Tartars and Mongols of Turkestan, Tartary and Mongolia are by most of us, at this distance, looked upon as uncivilized wanderers, but this is true with limitations. Large tracts of their habitat are sandy or rocky wastes, but in many parts and on their borders they are habitable and their inhabitants enjoy in a higher degree than is often supposed, the comforts and amenities of civilized life. Certainly their tents and their clothing and accoutrements are superficially unlike ours, but the inferiority of the occupants and wearers does not follow.

We need not think they have no enjoyments in their lives in their black tents, in their thin grass plains and their scarce springs of water. They have no dreams of life's luxuries, but can they not have their longings and strivings for better things in their inner lives? As a sign of this it is the desert dwellers of Syria, Palestine and Arabia, some entirely nomadic, to whom we owe our early conceptions of a religion purer than the grossnesses, not to say the sensualities, which pass for religion in the luxurious cities or among the inhabitants of the fat valley lands.

If these people were taken from their range free deserts to the wire-fenced plains of North America they would repine and long for their own homes, uncomforted by our motor cars, our radios and our multitudinous magazines. In urging insistently another way of life upon our

grain farmers, as our only salvation in a semi-desert, we cite these tent-dwellers to remind them, perhaps unnecessarily, that happiness does not depend on the place or the manner of living, but above all else, in interest in their work. Grain-farming work can yield an interest only while its problems arising from day to day absorb the mind. A mere contemplation of growing crops or idle conjectures on rainfalls, yields and prices are not work. In fact, the absence of varied interests in the single-crop grain farm itself accounts for the unrest and discontent of the farmers and their families, and, to be quite plain, the increase of mental ailments.

But is it then desired, one may ask, that our farmers living, as do the Tartars, Arabs and Mongols, on or within the borders of a desert, potential or consummate, should subsist like them, as the common though most erroneous thought runs, on mare's milk, locusts and wild honey *à la* John the Baptist? Not at all; we need not pattern our whole lives on theirs, while not forgetting that as far as this continent is in our minds, we have as yet made no such contribution to the world's knowledge as the Arabs in the arts and sciences, in architecture and medicine, chemistry and algebra, or in astronomy and arithmetic which could never have progressed without the Arabic notation. Our religious thought, too, is largely derived from the Semitic people of the arid regions of Asia.

What we have, we hold—a most healthy and indeed a beautiful climate, safety of life and property; schools, churches, newspapers, books and magazines (some a doubtful blessing, of course). Some think that such a farmer developing the technique of the steppe or steppe desert must sink down to the level of the most rude and uncouth peasant of Eastern Europe, of Armenia or of Kurdistan. I deny it. It is false! If one sinks down in the face of churches, books, and schools, it is not from hard and rough work, but from choice and indolence of mind, which single crop wheat-growing breeds and fosters.

THE SEMI-NOMADS

We come next to the partly-sedentary and partly-roving inhabitants of such places as oases in the true desert and their surrounding thin pasture lands. These vary from small oases, each with perhaps a single spring and a dozen palm trees with limited pastures, to districts vying in extent with the smaller Canadian provinces. Large parts of the Sahara are more correctly called steppes, that is, tracts of open country covered more or less sparsely with grass. It is said to have a population of two and a half millions. In it there are settled peoples, besides some partly nomadic, who regularly cultivate their lands, and grow vegetables, corn, millet and barley. They keep cattle and horses, sheep, goats and camels and these flocks, having a great range, find sufficient pasture. In every desert there are the settled homes of such people gaining more or less satisfactory living. By centuries of experience they know what will grow, and that they plant. They have also known from time immemorial what we are only beginning to suspect—that a very little improper cultivation of their steppe lands, their pastures, will convert them into deserts, depending in every region on its humidity, the crops that are grown, their treatment of the land, and their saving or waste of water. Their lives and activities are circumscribed just as are those of the farmers of the western plains by their water supply. The only real difference is that they are aware of their limits. They husband jealously their supply and dig to get and build aqueducts to lead it to their fields. Like dwellers on arid plains everywhere, they must meet their great enemy and ours, drought. The Arab knows it would be useless to cry out to Allah or to complain to his sheik if he were to plant wheat only, and neglect his flocks, his fruit and his vegetables. Like them, we must develop reliance on ourselves, not on princes, powers or governments.

One avoids the temptation to picture an idyllic life among these cultivators. They are, in fact, and in their Saharan way, the counterpart of serfs, their acknow-

ledged landlords are the marauding Tuaregs and Kabyles whose principal care is to collect the customary rents, four-fifths of the crops, including the dates and other products of the various kinds of palms. It is not to be denied that these landlord banditti do not rob, and suffer no fellow tribe from other regions to molest, their tenants. Their own interest forbids it. It is baron and serf; work on one side, protection on the other. Yet each oasis must protect itself against attacks from its immediate neighbor tenants on the next.

This feudal system is not, however, in full vigor in other deserts. From the nature of things it is a prelude to protection by a king and other strong central government. It will not likely be long before the sedentary oasis cultivators of the Sahara will be everywhere effectually protected by the French authorities against their too avaricious landlords and predatory neighbors. But, uneasy thought, will they, with complete governmental protection, grow soft in their morale, cease to build their underground water reservoirs, their foggaras and aqueducts, and call on the government for assistance and food? Let us hope that their habits of independence and self-reliance, indurated by centuries of desert life and desert dangers, will prove more tenacious than ours which have crumbled at the first shock of adversity. Perhaps with their harder lives their minds carry them high enough to look down upon and weigh at their true value both scarcity and plenty, both material comfort and hard living. There are such people in the world and doubtless many on our own steppes.

X

THE GRAIN FARMERS

Finally we come to the grain farmers of the North American plains. Let us begin with Bryant's "Gardens of the desert, boundless and beautiful," as he saw them in 1870.

The battle of the Plains of Abraham made an end of a deplorable period in the story of North America, when the American colonists and the French each incited their Indian allies to orgies of rapine and murder upon the isolated settlements of the other. The "One Perfect Volley" of Wolfe's redcoats destroyed the stimulus and support of the Canadian Indians, and the massacres of men, women and children at Oyster Bay, Schenectady, Fort Royal, Haverhill and Salmon Falls and of western Pennsylvania could never be repeated. The colonists, relieved from the constant dread of the tomahawk and scalping knife, turned their thoughts elsewhere. No sooner, then, had come peace under one flag and security to the white man among the Indians, than the settler laid upon these grassy plains his 'prentice hand. Their nature and their limitations was as little known to him as the steppes of Siberia or Central Asia; for all he knew they could be treated as the wooded lands of the rainy east. However, little harm was done for many years, for settlement was long confined to the alluvial lands of the Mississippi Valley with their luxuriant grass and deep humus soils.

But in the middle of the last century came the enemies of the short grass plains. Cyrus McCormick had invented the reaper—or at least had brought it into use, and with it the age of our deadly machine farming had begun. The close of the American Civil War let loose more than a million men whom four years of the army had spoiled for the quiet life of the eastern shops and farms. The Pacific railways carried them in thousands to the farther west. The two-bottom plough, the seed drill and the reaper soon followed and the destruction of the grassy plains thenceforth pro-

ceeded apace. The Canadians followed in the early 'eighties. In the 'nineties Roosevelt wrote, "The Winning of the West," where now his namesake, also a sincere man, seeks with various devices, such as tree-planting, the limitation of land-breaking and wheat-cropping and irrigation, to undo the harm the "winning" had brought about upon three hundred million acres.

In Canada, too, the West was "won" and we boasted that an empire had been added to our country. However, none of us knew any better; we cannot throw stones, but that need not make us shut our eyes to our gigantic failure. At this point some will deny our failure and point to the millions of bushels delivered every year to our elevators. No one has said that no wheat can be grown there or that the whole of our vast territories are uninhabitable by reason of drought. What is maintained is that continuous wheat cropping has already ruined vast areas of the dry belt in Canada and the United States, and, if exclusively persisted in, will, as is stated by the authorities, eventually reduce to a desert any region with only from 15 to 20 inches of moisture in the year. The Sanford Evans Service gave in 1935 15.64 inches annual rainfall as an average of 15 stations. Other authorities differ but fractionally.

The meteorological maps of Canada show that the rainfall in an immense area has been less than 10 inches on an average during the growing season, April 1st to September 1st, for the last forty years, and quite three-quarters of the inhabited parts of the Prairie Provinces have only 16 inches annual precipitation, or less.

All the books call such an area a steppe desert and as far as continuous grain-growing is contemplated, a potentially actual desert requiring only single-crop grain-farming and over-grazing to be made in time into an absolute waste. If irrigated or otherwise properly treated, it would be quite another matter. Ten inches, the books say, are the very least that suffice for grain crops and even this attenuated supply must be distributed in the right amounts and at the right times—a matter of chance entirely: witness, the poor distribu-

tion of the years 1936 and 1937. Even at that, when the books say that ten inches of rain will suffice for crops it is supposed that the usual farming methods will be followed, a rotation of crops including one legume crop and a fair amount of stable manure or a crop of clover ploughed down, but this is just what we have not done.

Again, if our lands rebel at their treatment do we deserve by our work upon them a high or even a fair standard of living or, does it give us a standing to claim assistance from the East? One gladly agrees that unremitting toil, however unsuccessful or wrong in its direction, should have recognition. Let us then see what is the actual labor on a single-crop grain farm.

Some four years ago the National City Bank of New York conducted a thorough investigation into the conditions and the actual working time on the purely grain farms in the semi-arid region extending from Springfield in Texas to Edmonton in Alberta, a little too far north, of course, as we know. The information gathered from every available source put it at not more than fifty-six days in the year. A more limited inquiry among farmers here does not lead one to increase the figure. A serious question, then, is here to be asked, and the grain-farmer should ponder it. Is any person in this workaday world entitled to a fair or good living on less than two months' productive work? Will the economic laws of the world allow it? Farming, with all respect for its need of brains, is not an occupation calling for highly concentrated intellectual effort for short periods in one's life which would justify his prolonged intervals of rest. Granted that the two months' work is strenuous through the long summer days, there are still ten months left. It is suggested with respect, that some part of the explanation for the plight of our prairie grain farmers may be found here.

Their competitors in every other part of the world work in their vegetable gardens, in their sheep sheds, their horse stables and cow barns, their hen houses and pig sheds. Yet even the winter feeding of stock involves little labor unless it is on a large scale and the small

farmer has still time on his hands and he makes many of the articles needed in the house and about his barns and farm, farm boots (no difficult task at all) and farm harness, and takes up every other task that promises saving or profit. As to the women, their work is at their spinning-wheels and looms and their other household industries, canning small fruits, making butter and cheese. Our competitors work while their crops are growing, their days of labor are more than three hundred in a year.

The farmer whose home is upon an island in the sea or upon an ocean littoral, as in England, Ireland, Belgium and Japan, often works upon his land throughout his comparatively mild winter. Not to be left behind in the economic race, the peasant in colder climates follows indoor industries. He really must do so, or waste the abundant leisure of the long winter. Work must in some way be made to compensate for ungenerous nature.

How far are we removed from such atmospheres of home industries? Except in our most prosperous province—Quebec—a spinning-wheel or a loom is unknown; in our own arts and crafts exhibitions a loom excites the attention usually bestowed on a holy relic or something once used by a cave man.

It does not matter where these peasant competitors grow their wheat. Competition is driving hard the workers in every trade, profession and calling, penetrating into every region of the world and invading its remotest corners. It is a far cry from California to Spain, the isles of the Aegean or the Tunisian oases. Yet their inhabitants by their dried fruits are competitors in the Halles of Paris, in Covent Garden and in the many market streets of New York. The heated or iced box-car and the cold storage holds of the tramp steamers have put their fruit stalls, so to say, side by side. Algiers competes with Alberta in the wheat market at Liverpool and the Argentine and Armenia with Australia on the quays of Antwerp and Rotterdam.

Can any class of mankind live on sixty days of work and three hundred days of restless indolence in such a maelstrom of competition? It cannot be done but

temporarily and by skimming for a period the riches of the region which has fallen into their hands.

There are many farmers in the north who will cry out against the above remarks of unutilized time, as inapplicable to themselves. It is heartily conceded. There are many others who can claim that they have made a beginning in mixed farming despite their meagre water supply, and are not buying their food and every other necessary of life at the village store. This is gladly recognized. It is of the essence of this essay to urge such a life.

But it will not, and indeed cannot, be denied that the life of the typical grain farmer is far otherwise. He produces wheat only, and with its proceeds buys everything. His house does not look like a home—no vegetable garden, no flowers, no trees, no household work, a barn in the midst of a huddle of old machinery, a place that lacks the interest of a home because there is no work in or upon it except to sow, reap and sell grain. It is certainly not his fault if he has not running water or a living spring. If, however, water for their cattle, fields and gardens is not to be had for the taking from spring and running streams, it can always be got by digging or boring. If the price of a windmill is considerable, the making of one at home offers no great difficulty, for the farmers of Europe make them. With a well and windmill pump the prime necessity for making a smiling homestead, a place of trees, flowers and gardens, has been attained. Of course it means work and careful attention to little things. The idea is out of fashion, yet it is as true on the farm as elsewhere that nothing worth having is to be got except by unremitting care and work.

One hesitates to reproach any one for mistakes of the past, much less the unfortunates who are suffering for want of food through wheat-crop failures, but it is cowardly not to draw the obvious lessons. For years past Canada has held the first place in the world's wheat market. Not only millions, but billions of dollars have been poured into the western farmers' laps. They knew dry years would come. Could not some of these billions have gone to bore wells, build windmills and make dams?

Now the Dominion Government is doing this work and actually paying the farmer four dollars per day to build his own dams and to dig his own wells. In all kindness, sympathy and compassion, is there not in this something grievously wrong? There is, and (have I said it too often?) its foundation is the attempt to farm a potential desert in a grand way—a land that only the most careful nursing can save.

As examples of the grain farmer's mode of life and his attitude towards the work of supplying his wants by his own work and ingenuity from the land itself, two stories are told.

One—the story of a farmer against whom permission to sue was brought by a storekeeper at the hands of the Debt Adjustment Board, for a grocery bill of \$700. Upon the bill being brought in and dissected, it was found that \$600 of it was for butter, eggs, meat, canned fruit, potatoes, vegetables and other things easily produced by work on the farm.

The other is of a farmer complaining against the banks and the cost of living and of wheat farming not paying. He was asked whether he had not practically all his living from the farm, meat, eggs, butter, etc. He said: "I suppose you want me to take an axe and murder a hog for my meat. I don't farm that way."

There are, no doubt, many exceptions, but it is quite apparent that the great body of the farmers in southern Alberta and Saskatchewan are wedded to the idea of growing wheat only, and with the proceeds buying food, clothing and all the other necessities of life, and getting few or none of them from the soil. It cannot be too often repeated that this is bringing and will always bring economic disaster, and, if accompanied by months of idleness, as it now is too often, mental and moral stagnation as well. Work, regular, continuous and according to one's strength, is the only antidote against mental and moral decrepitude, and as repeated elsewhere, it is the greatest pleasure known to mankind.

A technique for arid regions has been spoken of and it is only fair to say that the western farmers have partly developed a technique and indeed have done

wonderfully well for a short half-century of experience. Dry farming, strip farming, sweet clover, summer fallowing, wheat pools, irrigation, and now the limitation of wheat acreage, are all parts of it, but they are almost exclusively the technique of wheat growing as an exclusive crop. These things (our present technique) are not enough. They may suffice, indeed, for the area near our Rocky Mountains or other favored localities where the rainfall is more abundant and in some parts even generally sufficient for wheat-growing as exclusively pursued, but even there—at a ruinous cost in the end. Eastward from this favored belt where the country becomes progressively drier until we arrive at the Bad Lands of the Red Deer or at the country east of Medicine Hat, and thence eastward, in short, in more than three-quarters of the Prairie Provinces, exclusive wheat-farming will lead to national disaster.

The farmer of our prairies has not been extravagant though he might have been a little more provident and less carried away in the good years into land and crop expansion and somewhat less addicted to buying machinery. Yet he has carefully prepared his land and sown his seed year after year and still he has not succeeded. In widely extended areas he has either deserted his farm or is maintained by government aid, notwithstanding his abundant crops in some years.

Some farmers in favored localities have succeeded so far in making their living. The Saskatchewan farmers have had quite fifty years of it. Their yield per acre is only seventy per cent of Alberta's, for the latter has not yet gone so far in the impoverishment of the soil and the destruction of its grass lands. We are finding, too, that the evils of a protracted course of wheat growing in these arid lands multiply themselves. The less the yield per acre the more land must be cropped. The more land cultivated to throw back the sun's heat into the air, the less rain, because it requires cold air to precipitate rain. Grass land does not, but bare soil does, radiate heat, so that the air above it cannot be cool, and this radiation of heat helps to prevent rainfall. Then the less rainfall, the more soil drifting and, of

course, the less yield per acre, so a greater acreage is required, and so the circle is complete around which we travel blindly until we shall awake in a parched and exhausted waste.

A recent bulletin of the Dominion Department of Agriculture contains the essence of the matter: "Summer-fallowing, a cultural operation frequently necessary in order to eradicate weeds, and in the semi-arid districts of western Canada to conserve the moisture, tends to destroy the organic matter of the soil and thus dissipate its nitrogen. The removal of plant food in crops under irrational systems of farming in which there is continuous cropping and no attempt made to return the elements of fertility, is perhaps one of the most serious factors leading to the decreased productiveness of the soil. When the greater part of the crop is fed on the farm, as in dairying and stock-raising, a large proportion of the elements of fertility is returned to the land in the form of manure, provided the latter is properly preserved, and steps taken to prevent losses of plant food through fermentation and leaching."

But the wheat farmer has launched himself on quite another course, one compelling him to crop incessantly and so make the desert. Then with increased drought and cultivation, soil-drifting increases and this has now attained the gravest proportions. It shows again the imperative need of keeping water in the soil.

The course advocated to take the place of wheat farming will certainly be a peasant's life, and many will exclaim, "Not for me this life of a yeoman." The answer is that no one wants to prescribe this or any other life for anyone, or to tell him where he shall spend it. It is open to everyone to stay on our steppes or steppe deserts to "dree his weird" and grow wheat always; it is a free country and, God willing, will remain so.

But as we live on a steppe or in a desert we can only get what a steppe or a desert will give, and only that by a cunning knowledge of its ways and a careful adaptation of our own ways to its ways, and above all to keep in mind that we are not in the leafy and rainy east, but on the verge, if not in the midst, of a desert.

XI

THE TRUE FARMERS

From these sometime, but not always, oppressed tillers of the soil we pass to a class with whom we are better acquainted, the small farmers of the more humid parts of the world, Europe, America and parts of Asia where they are generally protected by the law. Here, too, the standards of living and amenities of life differ greatly from "the rude Carinthian boor (who) against the houseless stranger shuts the door," to the well-to-do farmer almost in the squire class in England who has his work done by farm laborers. But one and all are true farmers. One can have in his mind such a one as he may call a peasant, while another pictures the thriving farmer of Eastern Canada and the United States with his clean, comfortable and convenient house, surrounded by books, music and pictures. It does not matter what type is conjured up or what the difference is on the surface. The essentials of a true farming life are the same everywhere.

While the true farmer plants his vegetable garden his grain fields are growing: while he makes his clover hay, his cows are pasturing to yield "at the going down of the sun and in the morning," milk and cream to be in a few days butter and cheese. While he reaps his grain, his hogs and farmyard fowls are growing and fattening to produce meat and eggs for the table. After his grain is sown his brood mares are nursing their young—his, the farmer's future work-horses, and the wool on the sheep's back is growing thick and long for his home-made apparel. He rests on Sunday and takes his relaxation on other holidays, but not one of these beneficent gains which he can confidently leave to nature delays on its way: not one stalk of grain or bunch of grass stands still in its growth, not one day's growth of his farm animals is lost. In winter he has time to care specially for his animals and for relaxation and reading. So he fits his work to each task in nature's time and season while all around him his flocks and herds grow and his

grain ripens, until their turn comes for attention. Thus his work, in its diversity, is continuous, and whatever the unthinking may say, these are its greatest interest, benefit and gain both for his body and mind. Some, if they take no interest in their daily round, may call it drudgery and menial work, words of a small mind and incorrect. Menial labor is personal work for another, which a farmer's is palpably not, and no work is drudgery unless the mind makes it so. Farm work is the very opposite and has advantages of experiment, change and study unshared by other occupations. That it demands constant care and thought, that is why it is ennobling to the mind; some of its tasks may soil the hands; they never stain the soul. This life is so insistently, so clamorously and, if one likes, so tiresomely, urged because it is only the small farmer with eighty acres, as the Honorable Charles Stewart has said, who can stay the march of the desert upon us. For such an end is it not worth while to live even at times with soiled hands? But we have really no choice; if we do not thus fight the desert it will engulf us.

Farming, true farming, is a way of life. A way of life distinct from and indeed opposed to and largely inconsistent with business. Its secret of success lies in this, that the scores of things the true farmer does in his daily life bring him his living directly without the intervention or intrusion of the profit-seeking middleman. It is his legitimate aim to make his farm and his home as self-contained and self-sufficient as a beehive, which with no foreign help whatsoever is made (in a wild state) in a tree, the wax gathered, the combs made, the honey stored. The bee is the most efficient peasant in the world. If it is a disgrace to be such a farmer then the life of a bee is also a disgrace.

The farmer does not, and in our modern life of many wants cannot, equal the bee or the ant, whose self-containment attains perfection. But like the bee, the peasant farmer may secure from his lands, gardens, animals and his own labor, his wife's, his sons' and daughters' industry and ingenuity and self-denial, 80, 85, or 90 per cent of his and their wants. If he and

his family are devoid of these qualities there is no more to be said. No one can force such a life upon them. One freely recognizes that thousands of our farmers came here fascinated with the ease with which whole sections could be sown to and produce wheat by the tens of thousands of bushels, every bushel exchangeable for a dollar, or even more, and how unwelcome is the message that these golden dreams which once came true will not come true again, but that the economic laws of the world will finally require them to lead a different life.

One must recognize, too, his difficulties in taking up such a life. Not objecting so much to the work, his sons and, above all, his wife and daughters will want to appear in the town, village or city dressed as those they meet and not in homespun or home-knitted clothes. This is natural, but still not altogether the end of the matter, because they will go to an arts and crafts exhibition and admire the fine work and delicate texture of the work of French-Canadian women made in their own homes and on their own looms—looms, be it added, built by their own farmer husbands. It is the old story—we hold ourselves superior to these peasant women whose handiwork we admire, but whom, from indolence or incompetence, we tamely fail to emulate or copy. Our farmer will not forget that as he can get, say, ninety per cent of his wants from the farm, the prices at which he sells or buys what make up the remaining ten per cent cannot really affect him but to a very moderate degree. It is indeed very plain that anyone who is the sole master of ninety per cent of his life's needs cannot be much injured on the other ten. One can only urge the security and the safety and enjoyment that go with the real farmer's life and leave the decision to those affected.

With some hesitation one has used the word peasant because it is a word with a definite meaning and is the only word in our language which, properly understood, distinguishes the man who produces on his land all or nearly all his food, a good part of the clothing and many of the implements worn and used by himself and his family, from the person who grows and sells wheat

as his one and only crop and buys all his needs at the store. Granted that in many parts of the world, in backward districts, the peasant lives, uncouth and sordid, dirty and squalid, ignorant, morose and boorish, a life intolerable for us; yet it means no more than this, that there are peasants and peasants—those who sink and those who refuse to sink. The Pilgrim Fathers were peasants; the French settlers who defied the forest, hunger, cold, a rocky and unwilling soil, bloodthirsty Indians, government neglect and oppression and in the end made a smiling country, were peasants; the United Empire Loyalists were peasants, every settler in eastern Canada was one, the Covenanters were shepherds and peasants on the hills and braes of Scotland; the Waldenses and Albigenses of the mountain valleys who defied the united might of Louis XIV and the Inquisition, were peasants. Let us, city and country dwellers alike, be quite sure, not whether we are superior to these peasants, but whether we are worthy to stand beside them.

One should not need argue in favor of the life and work of these genuine workers who live upon and nourish as a friend their mother earth. So cherished and cared for she will not fail them. It is the only way. Others have thought well to treat her as a vassal to be despoiled on their annual forays upon her from their homes in the cities. It will not do, as the scorching experience and failure of our western wheat farmers is proclaiming from the housetops in storms of dust and sand.

If we make the most of our fields, barnyards, stables and gardens, use frugally all our farm and farm stock resources, read good books and magazines, support our schools and churches; if our sons take a pride in their animals, one perhaps taking prizes for pure-bred cattle, pigs, or sheep, another for some high strain of fowls, the daughters for home-made woollen scarves, sweaters or even whole knitted suits, another son devoting himself perhaps to bees or to prize vegetables or flowers; if we keep ourselves and our lives clean and gain and keep the respect of our neighbors and our self-respect, it will

not matter what we are called; what we will be is peasants. If we grow wheat alone and then, if that fails, we sit down dejected and spiritless to call on our government for aid, the finest names in our language, agrarian, agronomist, farmer or agriculturalist will not avail us. Hundreds of farmers, men and women, have abandoned their land and are flocking into our cities on relief, not because they could not gain their livelihood from their farms, but because they foolishly refused to be peasants.

XII

NO FAULT OF THEIR OWN

It is an unpleasant duty to dwell, however briefly, upon the plight of those farmers who have contemned and neglected the rules of farm life. To the number of 87,000 they had abandoned in one province 18,000,000 acres by 1934 and have since been pouring into our cities for relief or are demanding and getting charity from our governments. They have proclaimed, and in this they have the support of our newspapers and public speakers, that misfortune has come upon them through "no fault of their own."

This phrase has crystallized into a catchword and is passing into a proverb. It is in the mouths of every one who thinks that people should be relieved, at the public cost, of the consequences of their indolence and folly. For journalists and other sayers of soft words it has just the right measure of unction, and as the combine saves labor the phrase saves them from thought. It is time, therefore, as far as one is therewith endowed, to expend a passing thought upon the exact meaning of the words in this field.

The word "fault" has to do double duty for the want of a distinctive word for two really different ideas. It may be used for a mere mistake, a mere lapse in taking a wrong turning or a mishandling of a tool, a failure to make a catch or the making of a mishrow on a ball field, or again a mistake in the management of one's business affairs, trade or calling. In none of these will a wrongful intent be imputed by the word. Yet we say it was his "fault."

On the other hand it may mean a moral delinquency, idleness, fraud or dishonesty in any form, or any of the other sins of the decalogue or litany.

Now the people who use the expression "no fault of my own" mean, we may fairly conclude, that they have neither done nor intended a moral wrong, and without pronouncing them altogether impeccable, we may

gladly concede that they have not been immoral and that their plight has not come from sinful courses.

Does it, then, follow that they have not committed "faults" in the management of their farms, that they have not neglected the teachings of their fathers, the ways of the thousands of generations of farmers gone before, the teachings of all the men who have spent their lives in the study of the soil and its needs?

The fact is that they have committed these faults; they have done the things they ought not to have done—followed wheat with wheat for half a century or more, and they have left undone the things they ought to have done; they have kept no cattle, they have spread not an ounce of farmyard manure on their lands; they have thrown aside crop rotation; they have grown no legumes; they have ploughed down not an acre of clover. If these economic sins of commission and omission have brought their downfall, does not the catch-phrase embody a falsity?

To push thought somewhat further, the mind will reach a No Man's Land where morality and immorality dispute possession. Do the farming faults of sixty years with lands ravaged for present gain and left to succeeding generations with their inner life destroyed, do these faults draw toward or away from the trenches of immorality? However that may be, Providence punishes with an equal hand mistakes, neglects and departures from right methods in our callings just as severely as it visits punishments upon us for our moral delinquencies. There is no escape from the punishment of one kind more than the other. One cannot be sure either that remorse will not be a part of the punishment.

XIII

OUR COMPETITORS, THE PEASANTS OF THE WORLD

Our competitors in other lands have been busy. They have extended their wheat fields, though not in steppe areas. In Italy and Spain, realizing how much easier it is to grow wheat, which requires but two months' work, than to tend grapevines, which need almost constant care, the grape-growers have torn up their vineyards to plant grain.

Let us, from this picture, turn to the farmer folks of other lands. In the milder regions they nurse their lands throughout the year. Where a closely-housed existence is brought about by the long and severe winter, it stimulates industries in the home. Some devote themselves to a meticulous care of their beasts, feeding them, currying their coats, and even caressing them as pets. This care brings its reward. But even the common tasks of the farm do not take all the day, and in many countries the farmer and his family work in metals, clay, wood and, more commonly, on the wool of sheep and goats, and in hot countries, in camels' hair. Not only for their own use, but for sale, and hence we have the peasant-made rugs of Persia, the shawls of Kashmir, the raw, woven silk of Tussore, in India, and of Shantung, in China; from Kashmir and from many other parts of the East, silver and copper work, brass trays and ornaments, cloth and carpets. In Tibet the men weave what is called putto cloth, some of it extraordinarily fine in texture and colour; and some of the Tibetans are artists in metallurgy. In one province the people produce swords, bells, teapots, earrings, charm boxes of gold and carved turquoise, and seals of artistic design and perfect finish. In various parts of Europe we get peasant wood-carvings, bobbin lace, violin strings and dolls. Then there is watch and clock-making in the Black Forest; wood-carving in the Swiss mountains; lace in Bohemia and in Italy; in Thuringia and Franconia, dolls which supply

the markets of the world. These, be it understood, are the peasant work for the winter months. And, of course, all these peasants use, wear and eat only what they have themselves produced, woven and wrought.

It is forced on them by hundreds of years of economic necessity, and now they have become fond of it and proud of the artistry of their products, for which there is always a market. We can have our own views about their habits and standards of living, but their wheat meets ours in the marketplaces of the world. We think to beat them with our "improved methods"; to meet and to overcome their continuous work, their care of the soil, by our fifty-six days with machinery.

These peasants do not, as we do, depend entirely on the sale of their soil's raw products. Now, the raw products of the earth, the raw materials of the world will always be cheap because they are produced by raw, unskilled labour. Every illiterate peasant in the world can grow wheat, plant fruit trees, and catch fish, and in consequence, these hundreds of millions of workmen, to the numbers of whom there is practically no limit, are competing against us in a buyer's market to sell their raw material. It is not that every raw, uneducated man can be an ideal farmer or a skilled fisherman or miner, far from it, but they can all grow wheat. When these raw materials of whatever kind are sold, wheat, oats, wool, hides, flax, they go through the hands of perhaps forty or fifty more or less skilled workers, buyers, jobbers, mechanics, teamsters, wholesalers, retailers, clerks, salesmen, etc., each getting wages or profit out of them as they journey from the place of production to the beautiful department stores, finished and enticing, as they now appear on the shelves for sale back to the original producer. A few ounces of his wool or cotton or oats or wheat is now transformed into a shirt or into breakfast oats or shredded wheat, all in dazzling packages, which he buys by the ounce at the same price as he first sold it per bushel or per hundredweight. In other words, our wheat-farmer sells everything and buys back everything. He gets, for his raw material, the raw producer's price,

the very lowest; he buys it back as a finished article at the very highest. The skilled mechanic who wove his wool or yarn, or ground his oats, or put them in their little radiant packages, is not in the same position. He gets skilled wages with which to buy.

Thus our farmer, the grain-farmer, is at both ends of the economic ladder, he is both the original producer and, in a few weeks, the ultimate consumer of the same material, and he pays the wages and profits of everyone who has handled it in the meantime.

His true way of life is by his own work to keep himself out of this commercial circle, out of reach of the Juggernaut that would crush him, out of the maelstrom that will drown him. He, therefore, lives by consuming his own products and by making his own clothes and boots and shoes out of the abundant products of his land, his sheep, his cattle and his hogs. He goes further and makes his own implements as far as possible. Only by this way of life can he escape the bankruptcy which awaits everyone who sells cheap and buys dear. If he does not lead this life, he has idle time on his hands while his grain is growing and ripening; in this country, quite seven months of the winter, ten months in all. Who will or should pay him for this idle time?

Among other things, we will keep in mind that the price of our wheat must meet that of our competitors, and the competitors of our farmers are people like the Russian moujik, who wears one sheepskin coat the year round and lives in a hovel, the Egyptian fellah, the Indian ryot, who wears one garment only, a granny nightshirt in effect, which cost, perhaps, twenty cents; the Roumanian, the Spaniard, the Algerian, and many other peasants, living on much the same level. Their wheat competes with ours at Liverpool, Antwerp and the other importing markets of the world, where prices are fixed by the quality, not by the cost of production.

A second reason is that railway building is constantly extending into new countries and into the backward parts of the Old World, as in Asia Minor, India, China, Siberia, Africa and elsewhere. Wheat, which has been grown there for thousands of years, but could not be

profitably shipped out by camel, mule or bullock wagon, is now thrown on the world's markets by these railways. This will go on for many years to come, and any substantial rise in the price of wheat will set tens of thousands of peasants all over the world, now within the reach of these railways, at planting more.

Now we—farmers and city-dwellers—are parvenus, newcomers into the steppes of the West. Where should we look for guidance? To the farmers and the farmers' papers of Europe, the eastern States or eastern Canada, each with from thirty to forty inches of rain or more? Or should we go to people whose terrain is like our own, the Arab, the Indian, the Tartar, the Mongol or the Chinaman of the semi-desert? Is the idea humiliating? Is it repugnant to our self-love and vanity? No doubt. But is there any alternative?

XIV

THE HARD AND ONLY ROAD

A condemnation of our present farming technique and its aims, single-crop grain-growing makes a legitimate demand for a plain exposition of an alternative way of farming life. From an early, and at times an arduous, training in mixed farming, and a somewhat prolonged comparison of its methods and results with those of single-crop grain farming and its consequences, and some personal acquaintance with arid regions in other continents, the writer ventures to outline the ways which all arid regions demand, always well aware that the ways of the true farmer will vary from any pattern, however good. It is not one based on theory. Scores of farmers are now practising it on our plains and the desert stops at their fences; millions live by it in the Old World.

For a foundation, it is taken:

(a) That our seasons will usually have but a scant rainfall with the common deserts' phenomenon of a deluge that melts down their denizens' clay-built villages.

(b) That soil drifting is making dangerous inroads upon our phosphorus reserves.

(c) That nitrogen has been going very fast. It has been oxidized, that is burnt by summer-fallowing and other ceaseless cultivation.

The supply can be fully restored and kept up by clover and other legumes.

It is also taken that a farmer, beginning in the humblest way to rehabilitate his land, will have at least a pair of horses (mares by all means, if possible), a plough and a harrow, or seed drill. The first step is to procure two or more cows with calves or due to calve or "freshen" shortly, and a moderate amount of feed for them. Pasture will not be lacking in any case until July. Then a brood sow, which for the time being will live on grass and the refuse from the kitchen. Next, an acre of the best available land, to be most carefully prepared for a garden, and as much for

potatoes. If there is stable manure to be got it should be lavishly spread on the garden and the potato acre. There will be droppings from domestic fowl and other animals. In the fields it cannot conveniently be gathered, but in and around the buildings it should be collected daily, and with any procured elsewhere, dug or ploughed at once into the above plots. Not for a day or even less should it be exposed to the air and sun, for, from the time of dropping, it loses ammonia. Its precious parts are phosphorus and nitrogen (as ammonia), but they are not its only value. The plants require its carbon and its mere presence in the soil gives good tilth, and further, bacterial life will swarm within it. With these droppings, and with other manure begins the long and hard fight of redeeming the wheat-cropped and ruined land. It can be done—no magic, but work and care.

The farmer will find that, with eight or ten fresh eggs a day, and ample milk, his table will never lack sustaining food. Vegetables will soon come to hand and, in August, potatoes. Then he must make a beginning upon the rest of his quarter section. With his limited stock of horses, cattle, pigs and fowl, he cannot well expect, in the first year, to treat more than ten, and perhaps not more than five, acres near his house. He should go slowly and treat a small part generously, so that the results will leap to his eyes, rather than spread his work and manure thinly over a larger field. If he manages to manure five acres, and sows clover with whatever crop he thinks best on another five acres, he will, at the end of the year, have justly and fairly treated twelve acres. Whatever the season's moisture may be, he will get fodder for his stock. If he can manage another five acres in peas and beans, his total soil-building area will be still greater. As to the rest of the quarter section, if he grows oats, wheat, and barley on a part, the added injury in one year will not be great.

We have premised for him a dry year, but not the worst. If he has secured ample manure, hitherto largely or entirely unused, from his own barnyard or

elsewhere, his two acres of garden and potatoes will stand a lot of drought if kept stirred pretty constantly with the hoe. Yet he must have a well, perhaps quite deep, and a windmill, and if possible it should be placed on ground above the clover field and home plantation, so that some water from it will eke out the rain, for it is not to be supposed that May and June will not yield some rain and if, by dint of work and water from every source, he can secure a good stand of red clover, he can rest easy about that five acres for some time.

It will need care, work and management, without cease, but the undertaking is to bring back land in a desert; it cannot be done by riding a tractor: by no means.

Then green fodder of some kind will likely be required for all his animals in July and August. There are crops which will grow more or less luxuriantly in May and June and be fit for cutting for feed in July. It means more work and the farmer must consider the possible situation carefully, and perhaps put on fewer cattle, or devote more attention to fodder crops. He must constantly think, and work, not, of course, to follow slavishly this outline, yet it must be on these lines. He will succeed with his land and he will have established a home in the face of the desert. His greatest success will be in himself, for his work and thought will have made his character.

If his resources are greater than we have supposed, so will his progress be.

There is much argument whether or not trees bring rain. One can scarcely doubt that if, by magic, the whole of Palliser's Triangle were covered with trees and their undergrowth, much more rain would fall upon it; not that they attract rain directly, but that the deadly rain-preventing refraction of heat from sand and summer fallow would be absent. But it is doubtful if any marked increase in rainfall would follow the planting of trees within the practical limits of our abilities and resources.

But whatever the truth on this vexed question, a thick belt of trees should, as soon as possible, be planted

around each field and garden plot. The ground should be most thoroughly prepared as for a crop and when planted the trees should be treated and cared for as a crop, and as a most valuable one.

The wind cannot sweep away so completely the moisture within the shelter, and the snows of winter will also be kept until the ground can absorb the moisture. One does not forget that, theoretically, the snow covering must melt before the frost can be taken out of the ground, but the farmer will not be beaten by this theory. The same, with perhaps less marked benefit, will accrue if the area enclosed be larger than five acres.

It seems again more work, but the answer is the same as before, he has the desert to outwit, not merely an undesirable condition to overcome in a haphazard or perfunctory fashion.

These small fields will not lend themselves to farming with combines and the like: so much the better.

From these small and arduous beginnings the resolute and industrious farmer will, in a few years, find himself the master of his permanently rejuvenated land, and can look with pity on those who would foolishly pity him.

It is the only way; it is the way which could have been followed much more easily from the beginning. All plans for a rehabilitation based on an eventful resumption of the soil-destroying methods of the past have one certain future if they are followed—still greater disasters. In no deserts are such ways attempted except in North America.

The writer is not without a knowledge of the deluges of water which, at times, fall on all deserts, nor of the likelihood that of a decade, two or three of our seasons will be quite humid and one or two more moderately so. What he would say is that with unchanged methods and soil losses every year, we are upon a sand-based structure.

To plant desert grasses from the Gobi is good. As in their far-off homes, where they yield herbage for the camels of the infrequent caravan, they will here do somewhat better, but to restore our plundered soils—

well, the ice cap left us perhaps fifteen thousand years ago and in that time our prairie grasses have given us a legacy of four, five or, in places, six inches of vegetable matter. How much can we expect from Nature in a lifetime?

We can, in fact, expect but little more upon the whole problem from governmental aid—or interference! Though it can pauperize it cannot rebuild either the lands despoiled or the habits and self-dependence of its owners. The Honourable Mr. Dunning plainly told the House, during the debate upon the dry areas situation, that the farmer's salvation depended upon himself alone.

XV

THE MENTAL EFFECTS OF SINGLE-CROP FARMING

The effect of the existing economic conditions of the western plains upon the minds of their indwellers does not escape notice and, as a basis of an inquiry, is taken a statement of Retzel, the great writer on Anthropogeography, of which science he may be called the founder. After pointing out the varied activities of island countries, or countries bordering on the sea and having inlets, gulfs and bays to furnish harbours, he says that this variety of interests, conditions and occupations has the effect of stimulants upon the minds of its people.

The countries of forests, lakes and mountainous regions have their inherent incentives to physical and mental activity, not always devoid of the acute stimulus of danger. There can be little doubt that the northern regions of our own country should, for this reason, develop a more active mind. So with a seafaring life, full, at times, of danger to be anticipated and circumvented, always of hardship, and, at times, filled with sights of strange lands, peoples and ways of life. On the other hand, of wide, level plains, Retzel says:

Vast plains and steppes as compared with the diversified lands of western Europe, develop a dead uniformity of mind and habit barren of intellectual progress. Such areas, too, if shut off by mountains from the moisture-laden winds of the ocean, as the western prairies of North America and the steppes of Mongolia, can never be of great economic importance.

Then, when there is added to the dead level of the country a monotonous sameness of occupation, and, within that one occupation, the growing of one crop requiring but two spurts of activity in the year, the effect is still less stimulating. From one end to the other of our plains, the one pre-occupation fills our minds, not of the farmers alone, but the people of every city, town and village. They ask each other daily: "Shall we get rain?" "Shall we get enough for the

wheat?" "The crops need rain now." Or "Will the prices hold, or will they fall, or will they rise?" Our thoughts are confined to a wheat-crop horizon.

The need for mental activity is still more limited when the work is all done by machinery so that no care of horses gives even a small diversion of care and thought, however small and short. A fully-planted garden would give a blessed mental relief. If there be no garden, then spinning, knitting, weaving, would give interest to the women folk, but there are no sheep and no wool, and they are despised and forgotten arts. The making of bread involves several processes requiring care, as does butter-making. The last means cows; they are non-existent. Both bread and butter can be bought at the village store. There is no need of mind exercise in the matter. The happiness that comes from the humblest and hardest work well done is not theirs. Money happiness, not work happiness, is the goal of the wheat producer.

Let us try to imagine what fills the minds of the wheat producer, his wife, daughters and sons during the ninety or ninety-five days between the sowing of their crop and its harvesting. Idle speculations about rain or wheat prices are not thought. They may plough and harrow down a summer fallow, or go over it with some tractor-drawn machine in favour at the time, likely they do, but it is a mere routine in any case.

It is little wonder, then, that, for distraction, they find continually some reason for a visit to town. They may even have an errand for some household need, seeing that their homes produce nothing. It is no more surprising that they visit the wheat brokers' place of business, where they can, at least, meet their fellow farmers, equally at a loss for mental occupation. If, then, they are tempted to go into the market, is it not a natural consequence? There is, at least, some diversion for the mind. If, in the market, wheat-crop money be lost, as it is likely, then seed wheat must be given them for the next season. Thus the farmer's monotonous life has turned him from the traditional farmer into a gambler, using the word in no offensive sense.

Uncertain as the seasons are, he gambles his time and labour, not too much of either, and his seed grain (often supplied by the government) on a good season and a plenteous yield. He puts up little, hardly anything in cash, in comparison with his possible winnings.

Next he gambles on a rise of the price. Here, too, the chances are all against him. He pits his vague conjectures upon the probable rise or fall of the market against men whose business is to know all the factors, men all of whose sources of information are beyond his reach. He loses, but from mere *ennui* goes over the same course the next year. He has nothing else to occupy his mind.

No one suggests anything approaching universality in these pictures, nor even conjectures the percentage whom they truthfully represent. It is, in any event, too large and not at all uncommon. But whatever the extent of mind torpidity on the western plains, its cause is identical with the soil's sterility, one-crop farming.

When we have added the weakening influences of the system of doles and relief under other names, now sapping the ambition of large sections of the prairie population, farmer and town dweller alike, the picture is not a pretty one.

DISCUSSION OUTLINE

FIRST DISCUSSION: *Chapters I-IV*

1. Draw an outline map of the West, and colour the areas represented by the three steppes. How have these steppes originated? What are the physical characteristics of each? What do these characteristics suggest as the most suitable uses to which these areas might be put?

2. What first attempt at hydraulic engineering should be made to relieve the thirsty steppes? How does nature facilitate some such obvious enterprise?

3. Can you discover what precautions were taken by governments or land companies to guide the army of new settlers to lands most suitable for farming? Discuss scientific determination of our land resources in relation to a planned settlement.

READINGS

Atlas: showing Agriculture, Climate and Population of Prairie Provinces. Dominion Bureau of Statistics, 1931.

Any map which shows the two lines of hills: (i) in Manitoba and Saskatchewan, from Pembina Mountains to Pasquia Hills; (ii) and in Saskatchewan and Alberta, from Wood End (about Range 14 west of 2nd Meridian) by way of Biggar and Battleford, to Fort McMurray.

Surface Water Supply of Canada. Water Resources, Paper No. 68, Department of the Interior, Ottawa.

The University of Alberta Extension Department paper, prepared by Mr. Donald Cameron, M.Sc., Department of Agriculture, Edmonton, on planned settlement.

Alberta Government Reports on East Tilly and Berry Creek areas.

Soil Moisture and Crop Production. By S. Barnes and E. S. Hopkins. Department of Agriculture, Ottawa. Bulletin No. 130 (New Series).

Water Resources. Paper No. 6. South Saskatchewan Water Supply Diversion Project. Department of the Interior, Ottawa. (1914.)

Report on Irrigation for the year 1913. Department of the Interior, Ottawa. (1914.)

SECOND DISCUSSION: *Chapters V-VI*

1. What are the special evils of *mining* the soil? Relate this to similar evils of mining other natural resources, e.g., forests.

2. What countries can teach us useful lessons regarding planned replacement of our great resources?

3. What simple means would you recommend as a first step to restore our mined-out soil?
4. How are deserts man-made?
5. Take three or four typical cases of foreign deserts; how were they caused? How do they grow? How are they arrested?
6. Do appearances or experience indicate that we have a great Canadian desert in the making?

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- Wooded Soils and Their Management.* F. A. Wyatt and J. D. Newton. Department of Extension, University of Alberta.
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- Deserts on the March.* P. V. Sears. University Press, Norman, Oklahoma.
- Soil Fertility Losses Under Missouri Conditions.* University of Missouri Bulletin No. 324.
- Report on Rehabilitation of Dry Areas of Alberta, 1935-1936.* Department of Agriculture, Edmonton.
- Man Made Deserts.* Prof. C. W. Lowdermilk. *Pacific Affairs Magazine*, 1935 (Volume 8, December number), Jersey City.
- Soil Survey of Alberta, Sounding Creek Sheet.* Wyatt and Newton. University of Alberta. Bulletin No. 16, 1927.
- The Pearce Plan.* William Pearce, C.E. (Out of print.)
- Fountains in the Sand.* Norman Douglas. Martin Secker.
- Three Deserts.* Major C. S. Jarvis. John Murray.

THIRD DISCUSSION: *Chapters VII-VIII*

1. How is soil formed? What are its most essential characteristics? How may its ingredients become exhausted? How replenished? Does soil analysis assist the gardener as well as the grain-grower? How?
2. What are the irrigable areas of the Canadian West? The non-irrigable areas? What would you recommend for each?
3. Draw a map showing the artificial lakes which might be created in Saskatchewan and Alberta. Would this be enough?

4. What advantage would it be to restore large areas to grazing lands? Would you recommend pastures and wood lots? How would either of these remedies affect economic and social life on the prairies?

READINGS

- Practically all writers under First Discussion.
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 University of Saskatchewan.
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Soil Moisture and Crop Production. By S. Barnes and E. S. Hopkins. Department of Agriculture, Ottawa. Bulletin No. 130 (New Series).
Legume Inoculation. F. A. Wyatt and J. D. Newton. University of Alberta.
Soil Drifting and Its Control. F. A. Wyatt, J. M. Smith, R. Newton and C. C. Gillies. Department of Extension, University of Alberta.
Western Prairie Soils. Frank T. Shutt, M.A., D.Sc., Dominion Chemist, Department of Agriculture, Ottawa. Bulletin No. 22 (New Series).

FOURTH DISCUSSION: *Chapters IX-XII*

1. How may the different primitive types of farming abroad be classified? Explain the characteristics of each group. Do you note any resemblance in any of them to certain Canadian aims and methods?
2. What factors, soil, invention, etc., made grain farming possible? What were the good and bad points of the grain farmer's aims and methods?
3. How would you define a "true" farmer? What especially distinguishes his aims and methods?
4. Can the Western farmer unaided undo the damage done the prairie soil? Is the problem one for the prairie governments? Should all Canada attack the problem: (a) for sentimental reasons; (b) for political reasons; (c) for economic reasons? Is Canadian prosperity possible apart from a prosperous West?

READINGS

- See most of the references listed above, especially those by Lyon, Shutt, Lowdermilk, Wyatt and Newton.
Legume Inoculation. F. A. Wyatt and J. D. Newton. University of Alberta.
Report of the Chemist (1905). F. T. Shutt, M.A., F.I.C., F.C.S. Department of Agriculture, Ottawa.

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F.I.C., F.C.S., Department of Agriculture, Ottawa.
Alkali Soils. F. T. Shutt. Department of Agriculture,
Bulletin No. 21 (New Series).
World Agriculture. Oxford University Press.

FIFTH DISCUSSION: *Chapters XIII-XV*

1. How are foreign peasants competitors of the western Canadian farmer? How are the peasant and the farmer alike? Unlike? What special economic advantages do each enjoy?

2. What may the western farmer learn from the European peasant? Name the most useful lessons in the order of their importance.

3. Since rainfall cannot be increased, and since desert areas tend to grow, outline a practical way back for the West: (i) What the governments of the Provinces should do; (ii) What the Dominion might do; (iii) What the farmers themselves should do.

4. What psychological effect has the present system of grain growing in the West had upon the farmer and his family? How has this affected the rest of Canada? Is "gambling on the weather" a characteristic peculiar to the West? What desirable and undesirable qualities do you find in the characteristic?

5. Since most of the West is given over to a one-crop program, how would you employ your leisure if you were similarly placed?

READINGS

Their Daily Bread. W. H. Moore. Pickering, Ontario.
The Prairie Provinces in Relation to the National Economy of Canada. Bureau of Statistics, Ottawa, 1934.

A Report on the Rehabilitation of the Dry Areas of Alberta and Crop Insurance, 1935-1936. King's Printer, Edmonton.

Tree-Planting on the Prairies of Manitoba, Saskatchewan, and Alberta. Norman M. Ross, B.S.A., B.F. Department of Agriculture, Bulletin No. 144 (New Series).

Wooded Soils and Their Management. F. A. Wyatt and J. D. Newton. Department of Extension, University of Alberta.

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